SIEMENS

LEONARDO DR/DSA VA30A

[redacted] AX

DICOM Conformance Statement

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Network Conformance Statement

1 Introduction

1.1 Overview

The Conformance Statement describes the DICOM interface for the Siemens LEONARDO DR/DSA VA30A in terms of part 2 of [DICOM].

This introduction describes the application's implemented DICOM functionality in general terms.

1.2 Scope and Field

The Siemens product LEONARDO DR/DSA is a Multipurpose Workstation for Viewing of Images derived from digital R/F, Angiography and Interventional Procedures. The LEONARDO is designed to be integrated into an environment of medical DICOM-based devices. LEONARDO supports the storage of images utilizing the DICOM "Storage Service Class", the retrieval of Images from a PACS System utilizing the DICOM "Query/Retrieve Service Class" and the print of images on a printer utilizing the DICOM "Print Management Service ". Furthermore the handling of CD offline media is supported as a FSC, FSU and FSR.

1.3 Audience

This document is intended for hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

1.4 Remarks

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality as SCU and SCP, respectively.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.

The scope of this Conformance Statement is to facilitate communication with Siemens and other vendors' Medical equipment. The Conformance Statement should be read and understood in conjunction with the DICOM 3.0 Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

- The comparison of different conformance statements is the first step towards assessing interconnectivity between Siemens and non-Siemens equipment.
- Test procedures should be defined and tests should be performed by the user to validate the connectivity desired. DICOM itself and the conformance parts do not specify this.
- The standard will evolve to meet the users' future requirements. Siemens is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.
- Siemens reserves the right to modify the design and specifications contained herein without prior notice. Please contact your local Siemens representative for the most recent product information.

1.5 Definitions, Terms and Abbreviations

Definitions, terms and abbreviations used in this document are defined within the different parts of the DICOM standard.

Additional Abbreviations and terms are as follows:

ACR	American College of Radiology
AE	DICOM Application Entity
ASCII	American Standard Code for Information Interchange
AX-WS	AX-Workstation (for Angiographic/Radiographic viewing)
CSE	Customer Service Engineer
DB	Database
DCS	DICOM Conformance Statement
DSA	Digital Subtraction Angiography
IOD	DICOM Information Object Definition
ISO	International Standard Organization
NEMA	National Electrical Manufacturers Association
O	Optional Key Attribute
PDU	DICOM Protocol Data Unit
R	Required Key Attribute
RIS	Radiology Information System
RWA	Real-World Activity
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SOP	DICOM Service-Object Pair
U	Unique Key Attribute

1.6 References

[DICOM] Digital Imaging and Communications in Medicine (DICOM), NEMA PS 3.1-3.14, 1999

1.7 Structure

The LEONARDO Conformance Statement is subdivided into three Parts, which relate to individual documents needed to declare Conformance according to the requirements of "Part 2 - Conformance" of the DICOM Standard.

Those parts are:

- "DICOM Conformance Statement" for Network related Services
- An privately defined "Application Profile"
- and the "Offline Media Conformance Statement" to support local archive media.
- A general Appendix.

2 Implementation Model Verification

The Siemens LEONARDO DICOM Service Tool application requests Verification to verify the ability of a foreign DICOM application on a remote node to respond to DICOM messages.

Responding to Verification requests from remote nodes is handled by the Storage SCP application.

2.1 Application Data Flow Diagram

The LEONARDO DICOM network implementation is a Windows NT application and acts as SCU for the C-ECHO DICOM network service.

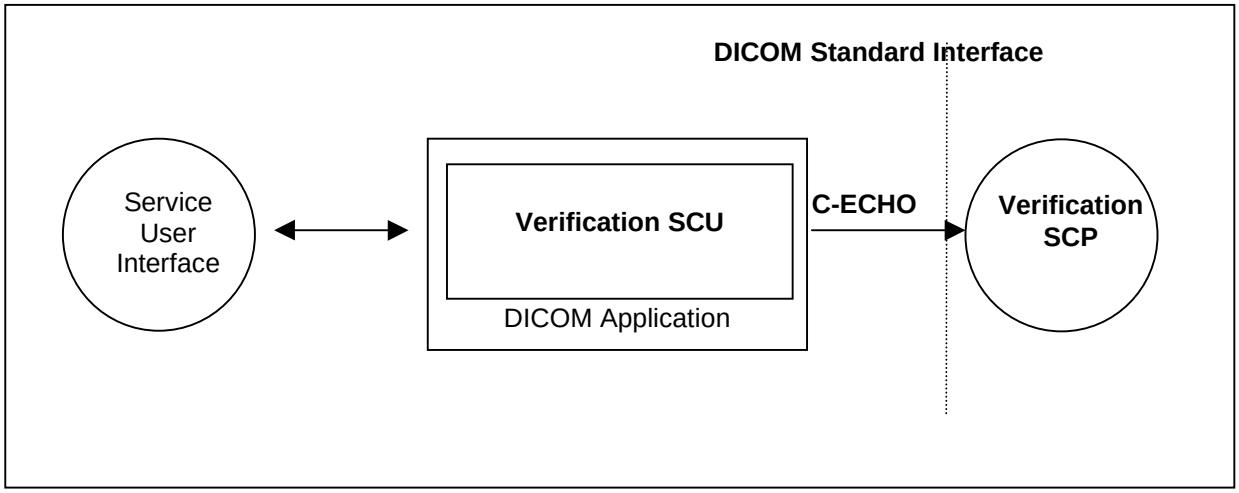


Figure 1: LEONARDO Application Flow Diagram - Verification SCU

2.2 Functional Definitions of Applications

The Siemens LEONARDO DICOM Service Tool application opens an association when a "Test" of a remote application is requested during a configuration session. This can be done when entering new data for remote application configuration or to verify existing configuration data.

2.3 Sequencing of Real-World Activities

Not applicable

3 Application Entity Specification Verification

3.1 Verification AE Specification

3.1.1 Association Establishment Policies

3.1.1.1 General

The Siemens LEONARDO DICOM Service Tool application attempts to open an association for verification request whenever the "test" function is activated during network configuration of a remote DICOM application.

3.1.1.2 Number of Associations

The Siemens LEONARDO DICOM Service Tool application initiates one association at a time to request verification.

3.1.1.3 Asynchronous Nature

The Siemens LEONARDO DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

3.1.1.4 Implementation Identifying Information

Implementation Class UID	1.3.12.2.1107.5.4.7
Implementation Version Name	“LEONARDO_VA30A"

3.1.2 Association Initiation Policy

The Siemens LEONARDO DICOM Service Tool application attempts to initiate a new association for

- DIMSE C-ECHO

service operations.

3.1.2.1 Associated Real-World Activity

3.1.2.1.1 Associated Real-World Activity – Request Verification

The associated Real-World activity is a C-ECHO request initiated by Service and Configuration SW environment whenever a "Test" is requested. If an association to a remote Application Entity is successfully established, Verification with the configured AET is requested via the open association. If the C-ECHO Response from the remote Application contains a status other than "Success" this will be indicated in the service environment and the association is closed.

3.1.2.1.2 Proposed Presentation Contexts

The Siemens LEONARDO DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table – Verification SCU					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.1.3 SOP Specific Conformance – Verification SCU

None.

3.1.3 Association Acceptance Policy

The Verification SCP is part of the Storage SCP – see section 5.1.3.

4 Implementation Model Storage

The Siemens LEONARDO DICOM Application Entity both originates associations for Storage of DICOM Composite Information Objects in Remote Application Entities and receives association requests for Storage from Remote Application Entities.

4.1 Application Data Flow Diagram

The LEONARDO DICOM network implementation is a Windows NT application and acts as SCU and SCP for the C-STORE DICOM network service and as SCP for the C-ECHO DICOM network service.

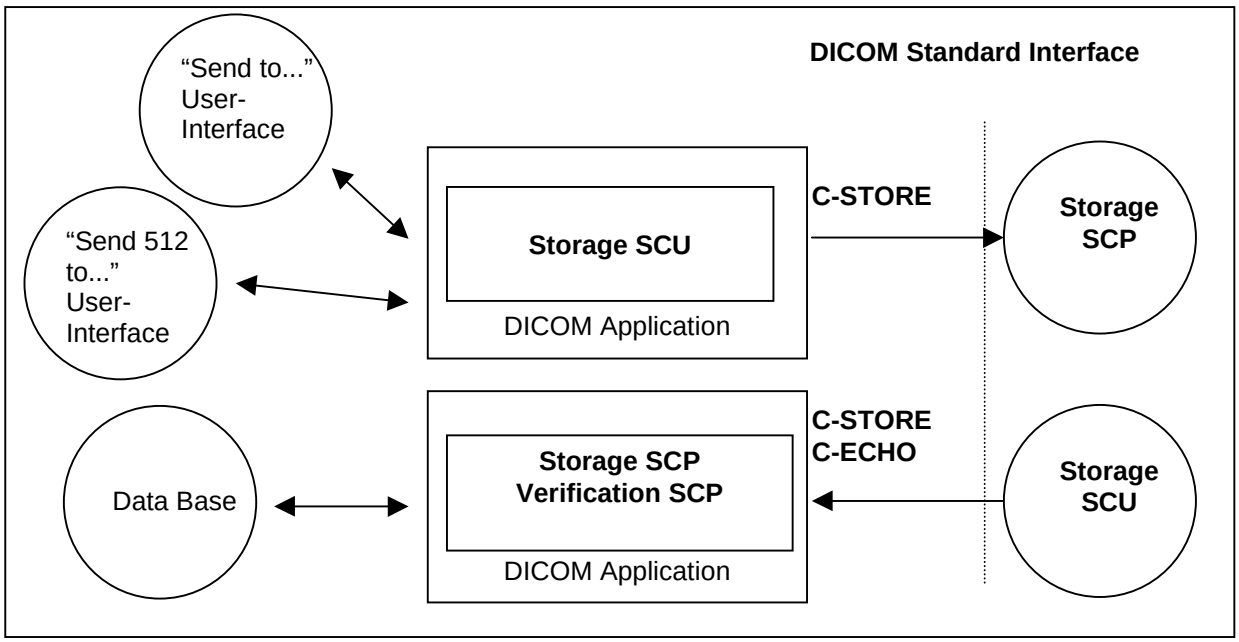


Figure 2: LEONARDO Application Data Flow Diagram – Storage SCU/SCP

4.2 Functional Definitions of Application Entities

The Storage SCU is invoked by the job control interface that is responsible for processing network archival tasks. The job consists of data describing the composite image objects selected for storage and the destination. An association is negotiated with the destination application entity and the image data is transferred using the C-STORE DIMSE-Service. Status of the transfer is reported to the job control interface. Sending can also be activated by the "Send 512 to..." interface of the Angio Viewer.

The Storage SCP component of the Siemens LEONARDO DICOM application is operating as background server process. It is existing when the machine is powered on and waits for Storage association requests. Upon accepting an association with a negotiated Presentation Context it starts to receive the Composite Image Objects and imports them to local database. Verification requests will be processed and responded by Storage SCP component too.

4.3 Sequencing of Real-World Activities

not applicable

5 Application Entity Specification Storage

5.1 Storage AEs Specification

The LEONARDO Storage service class user/service class provider applications use one AE when initiating/receiving associations to/from remote DICOM nodes.

SIEMENS LEONARDO DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Computed **R**adiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Computed **T**omography Image Storage	1.2.840.10008.5.1.4.1.1.2
Magnetic **R**esonance Image Storage	1.2.840.10008.5.1.4.1.1.4
Nuclear **M**edicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Ultra**S**ound Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Ultra**S**ound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Secondary **C**apture Image Storage	1.2.840.10008.5.1.4.1.1.7
X-Ray **A**ngiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray **R**adio**F**luoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2

SIEMENS LEONARDO DICOM products provide Private Conformance to the following DICOM V3.0 conform private SOP Classes as an SCU:

SOP Class Name	SOP Class UID
CSA Non-Image Storage	1.3.12.2.1107.5.9.1

SIEMENS LEONARDO DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as an SCP:

SOP Class Name	SOP Class UID
Computed **R**adiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Computed **T**omography Image Storage	1.2.840.10008.5.1.4.1.1.2
Magnetic **R**esonance Image Storage	1.2.840.10008.5.1.4.1.1.4
Nuclear **M**edicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Ultra**S**ound Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Ultra**S**ound Image Storage	1.2.840.10008.5.1.4.1.1.6.1

SOP Class Name	SOP Class UID
Secondary **C**apture Image Storage	1.2.840.10008.5.1.4.1.1.7
X-Ray **A**ngiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray **R**adio**F**luoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
Verification	1.2.840.10008.1.1

SIEMENS LEONARDO DICOM products provide Private Conformance to the following DICOM V3.0 conform private SOP Classes as an SCP:

SOP Class Name	SOP Class UID
CSA Non-Image Storage	1.3.12.2.1107.5.9.1

5.1.1 Association Establishment Policies

5.1.1.1 General

The existence of a job queue entry with network destination will activate the DICOM Storage Application. An association request is sent to the destination AE and upon successful negotiation of a Presentation Context the transfer is started.

The default PDU size used will be 64 KB.

5.1.1.2 Number of Associations

The Siemens LEONARDO DICOM application initiates several associations at a time, one for each destination to which a transfer request is being processed in the active job queue list.

5.1.1.3 Asynchronous Nature

The Siemens LEONARDO DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

5.1.1.4 Implementation Identifying Information

Implementation Class UID	1.3.12.2.1107.5.4.7
Implementation Version Name	“LEONARDO_VA30A"

5.1.2 Association Initiation Policy

If a job with network destination gets active in the job list the Siemens LEONARDO DICOM application attempts to initiate a new association for

- DIMSE C-STORE

service operations.

5.1.2.1 Associated Real-World Activity

5.1.2.1.1 Associated Real-World Activity – Send Image Objects to a Network Destination

The associated Real-World activity is a C-STORE request initiated by an internal daemon process triggered by a job with network destination. If the process successfully establishes an association to a remote Application Entity, it will transfer each image one after another via the open association. If the C-STORE Response from the remote Application contains a status other than Success or Warning the association is aborted.

5.1.2.1.2 Proposed Presentation Context – Send Images

The Siemens LEONARDO DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Computed **R**adiography Image Storage Service Class	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
Computed **T**omography Image Storage Service Class	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
Magnetic **R**esonance Image Storage Service Class	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
Ultra-**S**ound Multi-Frame Image Storage Service Class	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Ultra-**S**ound Image Storage Service Class	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
Secondary **C**aptured Image Storage Service Class	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
X-Ray **A**ngiographic Image Storage Service Class	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
X-Ray **R**adio**F**luoroscopic Image Storage Service Class	1.2.840.10008.5.1.4.1.1.12.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
CSA Non-Image Storage	1.3.12.2.1107.5.9.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None

Note: JPEG compression Transfer Syntaxes are supported only for monochrome images (Photometric Interpretation = "MONOCHROME1" or "MONOCHROME2")

5.1.2.1.3 SOP specific Conformance Statement

The LEONARDO DR Composing applications will create SC IOD type images when performing special applications that create Derived Images. The SC IOD will be a Standard Extended SC Storage SOP Class. The Angio Viewer will only display XA images and has functions to create derived XA images (Store Monitor images).

The LEONARDO (DICOM) application will not change private attributes as long as no modification is done. During a "Save as ..." operation all private attributes not defined within the LEONARDO DICOM application will be removed when the new object instance is created.

5.1.2.1.3.1 Optional Attributes

Data Dictionary of DICOM Type 2 and 3 IOD Attributes

Please see "A.3: overview of supplied attributes - SC derived image (Monochrome)" and "A.3: overview of supplied attributes - SC derived image (RGB)" in the Appendix for a list of all DICOM IOD attributes of type 2 and 3 which are encoded by the LEONARDO applications.

5.1.2.1.3.2 Specialized Information Object Definitions

The DICOM images created by Siemens LEONARDO DICOM application conform to the DICOM IOD definitions (Standard extended IODs). But they will contain additional private elements, which have to be discarded by a DICOM system when modifying the image.

The DICOM nodes are responsible for data consistency when modifying images. All unknown private attributes have to be removed upon modification!

Data Dictionary of applied private IOD Attributes

Please see "A.1 Siemens Standard Extended Modules" in the Appendix for a list of possible private IOD attributes.

5.1.2.1.3.3 Image Pixel Attribute Description for Grayscale Images

The Siemens LEONARDO DICOM application supports the Monochrome2 Photometric Interpretation with the unsigned integer 16-bit gray scale pixel and graphic overlay format. The lower 12 bits are used for pixel and the higher 4 bits are used for the graphic overlay:

Pixel plane

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "MONOCHROME1"
- photometric interpretation (attribute 0028,0004) = "MONOCHROME2"
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8, 16
- bits stored (attribute 0028,0101) = 8, 10, 12
- high bit (attribute 0028,0102) = 7, 9, 11

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 16
- bit position (attribute 60xx, 0102) = 12, 13, 14, 15

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 1
- bit position (attribute 60xx, 0102) = 0
- overlay data (attribute 60xx, 3000) = supported.

5.1.2.1.3.4 Image Pixel Attribute Description for Color Images

The Siemens LEONARDO DICOM application supports the RGB color image description with the unsigned integer 24-bit color image plane pixel format (not with Angio Viewer):

- samples per pixel (attribute 0028, 0002) = 3
- photometric interpretation (attribute 0028,0004) = "RGB"
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8
- bits stored (attribute 0028,0101) = 8

- high bit (attribute 0028,0102) = 7
- planar configuration (attribute 0028,0006) = 0.

5.1.2.1.4 Associated Real-World Activity - Send Image Objects 512 to a Network destination

From the Angio Viewing application it is possible to issue special send requests for the job queue. The images in this case are "pre-processed" to be compliant to the Basic Cardiac Image definitions (512^2 Matrix with 8-Bits allocated). Consecutive to the pre-processing stage the transfer is processed as with the normal "Send to..." RWA.

5.1.2.1.5 Proposed Presentation Contexts - "Send 512 to ..."

The proposed Presentation Contexts for this RWA are identical to those described in section 5.1.2.1.2.

5.1.2.1.6 SOP Specific Conformance - "Send 512 to..."

The "Send 512 to..." will allow conversion of any image that is displayed in the Angio Viewing application to an image that conforms to the Basic Cardiac format. Conversion is limited to reduction of Matrix Size and Pixel Depth and is restricted to be applied to "image-type" instances only. The converted image is a temporary copy and therefore a new Instance UID is generated.

The conversion will generate a Pixel Matrix output that is described by the following Attribute values:

- [0029,0010] Rows = **512**
- [0028,0011] Columns = **512**
- [0028,0100] Bits allocated = **8**
- [0028,0101] Bits Stored = **8**
- [0028,0102] High Bit = **7**

In order to preserve integrity of the data with respect to the original Matrix Size and Pixel Depth, the following attributes will be adapted accordingly for the resulting image:

- [0018,1602] Shutter Left Vertical Edge
- [0018,1604] Shutter Right Vertical Edge
- [0018,1606] Shutter Upper Horizontal Edge
- [0018,1608] Shutter Lower Horizontal Edge
- [0018,1610] Center of Circular Shutter
- [0018,1612] Radius of Circular Shutter
- [0018,1702] Collimator Left Vertical Edge
- [0018,1704] Collimator Right Vertical Edge
- [0018,1706] Collimator Upper Horizontal Edge
- [0018,1708] Collimator Lower Horizontal Edge
- [0018,1710] Center of Circular Collimator

- [0018,1712] Radius of Circular Collimator
- [0018,1720] Vertices of the Polygonal Collimator
- [0018,1164] Imager Pixel Spacing
- [0028,1050] Window Center
- [0028,1051] Window Width
- [0028,3002] MOD LUT Descriptor *("1st Pixel Value mapped" sometimes incorrect!)*
- [0028,3006] MOD LUT Data
- [6000,0010] Overlay Rows
- [6000,0011] Overlay Columns
- [6000,3000] Overlay Data

5.1.3 Association Acceptance Policy

The Siemens LEONARDO DICOM application attempts to accept a new association for

- DIMSE C-ECHO
- DIMSE C-STORE

service operations. Any Information Objects transmitted on that association will be checked on conformance and stored in database if check was successful.

5.1.3.1 Associated Real-World Activity

5.1.3.1.1 Associated Real-World Activity – Receiving Images from a Remote Node

The daemon receiving process will accept an association and will receive any images transmitted on that association and will store the images on disk in the own database if the conformance check is performed successfully.

5.1.3.1.2 Accepted Presentation Context – Receiving Images

The Siemens LEONARDO DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Computed **R**adiography Image Storage Service Class	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Computed **T**omography Image Storage Service Class	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
Magnetic **R**esonance Image Storage Service Class	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
Ultra-**S**ound Multi-Frame Image Storage Service Class	1.2.840.10008.5.1.4.1.1.3.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
Ultra-**S**ound Image Storage Service Class	1.2.840.10008.5.1.4.1.1.6.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
Secondary **C**aptured Image Storage Service Class	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
X-Ray **A**ngiographic Image Storage Service Class	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
X-Ray **R**adio**F**luoroscopic Image Storage Service Class	1.2.840.10008.5.1.4.1.1.12.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
CSA Non-Image Storage	1.3.12.2.1107.5.9.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCP	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCP	None

Note: JPEG compression Transfer Syntaxes are supported only for monochrome images (Photometric Interpretation = "MONOCHROME1" or "MONOCHROME2")

5.1.3.1.3 SOP-specific Conformance Statement – Receiving Images

The Siemens LEONARDO DICOM application conforms to the Full Storage Class at Level **2**. In the event of a successful C-STORE operation, the image has successful been written on disk in the Siemens LEONARDO image format.

The LEONARDO DICOM receiver returns the status Success upon successful operation otherwise one of the following status codes is returned and the association is aborted:

- Refused (A700):
  This error status indicates a lack of Resources (e.g. not enough disk space) on the LEONARDO modality.
- Error (A900 or C000):
  An error occurred while processing the image, which makes it impossible to proceed. The image will not be stored and the association aborted.

If an image instance is received that is identified by a SOP Instance UID that is already used by an Instance stored in database then the actual received image will be discarded. The existing Instance is not superseded.

The following sections will differentiate the attribute contents required for Image Viewing. The Siemens LEONARDO DICOM application supports more formats for Storage of Images.

5.1.3.1.3.1 Image Pixel Attribute Acceptance Criterion for Grayscale Images

The LEONARDO Viewing application accepts the MONOCHROME1 and MONOCHROME2 photometric interpretation pixel format and graphic overlay with unsigned integer and 8 or 16 bits allocated. Accepted values:

Pixel plane

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "MONOCHROME1"
- photometric interpretation (attribute 0028,0004) = "MONOCHROME2"
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8, 16
- bits stored (attribute 0028,0101) = 8, 10, 12
- high bit (attribute 0028,0102) = 7, 9, 11

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 16
- bit position (attribute 60xx, 0102) = 12, 13, 14, 15

Graphic Overlay will be shifted to fill Overlay Planes from Bit 12 and consecutive.

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 1
- bit position (attribute 60xx, 0102) = 0
- overlay data (attribute 60xx, 3000) = supported

The LEONARDO Multi-Modality Viewing application accepts also the MONOCHROME1 and MONOCHROME2 photometric interpretation pixel format with binary 2's complement integer and 16 bits allocated. This format is not supported for Angio Viewer display. Accepted values:

Pixel plane

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "MONOCHROME1"
- photometric interpretation (attribute 0028,0004) = "MONOCHROME2"
- pixel representation (attribute 0028, 0103) = 1
- bits allocated (attribute 0028, 0100) = 16
- bits stored (attribute 0028,0101) = 16
- high bit (attribute 0028,0102) = 15

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 1
- bit position (attribute 60xx, 0102) = 0
- overlay data (attribute 60xx, 3000) = supported

For MOD LUT, both the linear LUT (Rescale Slope/Intercept) and the MOD LUT SQ are supported and considered when pixel data is displayed. However there are two limitations. The MOD LUT SQ will be ignored in the following cases:

- signed pixels
- the pixel format is changed by the MOD LUT (e.g. 8bit -> 16bit)

If the MOD LUT SQ contains multiple LUTs, then only the first one is used.

For VOI LUT, both the linear LUT (Window Center/Width) and the VOI LUT SQ are supported (VOI LUT SQ with 8 or 16 bit LUT data)

But if both, a VOI LUT SQ and a linear MOD LUT, are specified within one image, then the value for Rescale Slope is restricted to 1.

If the VOI LUT SQ contains multiple LUTs, then only the first one is used.

Only a Rectangular Shutter Shape is supported in this version. Images containing other Shutter Shapes will be displayed w/o shutter.

5.1.3.1.3.2 Image Pixel Attribute Acceptance Criterion for Color Images

The LEONARDO Multi-Modality Viewing application supports the RGB color image description with the unsigned integer 24-bit color image plane pixel format. This format is not supported for Angio Viewer or DR Composing display. Accepted values:

- samples per pixel (attribute 0028, 0002) = 3
- photometric interpretation (attribute 0028,0004) = "RGB"
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8
- bits stored (attribute 0028,0101) = 8
- high bit (attribute 0028,0102) = 7
- planar configuration (attribute 0028,0006) = 0 (pixel interleave).

The LEONARDO Multi-modality Viewing application supports the “Palette Color” color image description with the unsigned integer and 2's complement pixel format. This format is not supported for Angio Viewer or DR Composing display.

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "PALETTE COLOR"
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8, 16
- bits stored (attribute 0028,0101) = 8, 16
- high bit (attribute 0028,0102) = 7, 15

Both 8-bit and 16-bit palettes are supported, but NO Segmented Palette Color LUTs.

5.1.3.1.4 Presentation Context Acceptance Criterion

The LEONARDO DICOM application will accept any number of verification or storage SOP classes that are listed above. The number of presentation contexts accepted is limited to the maximum of 127 (DICOM limit). In the event that the Siemens LEONARDO DICOM application runs out of resources, it will reject the association request.

5.1.3.1.5 Transfer Syntax Selection Policies

The LEONARDO DICOM application currently supports

- the Implicit VR Little Endian, the Explicit VR Little Endian and Explicit VR Big Endian Transfer Syntaxes
- the JPEG Lossless Non-hierarchical Transfer Syntax
- the JPEG Baseline and JPEG Extended Transfer Syntaxes (JPEG Lossy).

Any proposed presentation context including one of these Transfer Syntaxes will be accepted. Any proposed presentation context that does not include one of these Transfer Syntaxes will be rejected.

If a Presentation Context item contains a list of Transfer Syntaxes, the current LEONARDO DICOM application will take preference on the Implicit Little Endian Transfer Syntax. To allow

better control, the SCU shall choose to propose individual Presentation Contexts for each Transfer Syntax / Abstract Syntax pair.

With Implicit VR Little Endian Transfer Syntax the LEONARDO DICOM application will remove any Private Attributes not known to the application. Decision on removal of a Private Element is done if there is NO entry in the attribute-dictionary of the LEONARDO DICOM application.

Therefore any Explicit VR Transfer Syntax shall preferably be used by the Storage SCU's when sending Composite Image Instances to the LEONARDO DICOM application.

6 Implementation Model Query / Retrieve

The query/retrieve service class defines an application-level class of services which facilitates the management of images and patient data against the well-defined information model of DICOM and allows a DICOM AE to retrieve images from a remote DICOM node. The LEONARDO DICOM query/retrieve application supports the query/retrieve services to act as SCU and SCP.

6.1 Application Data Flow Diagram

The LEONARDO DICOM network implementation is a Windows NT application and acts as SCU and SCP for the query/retrieve network service.

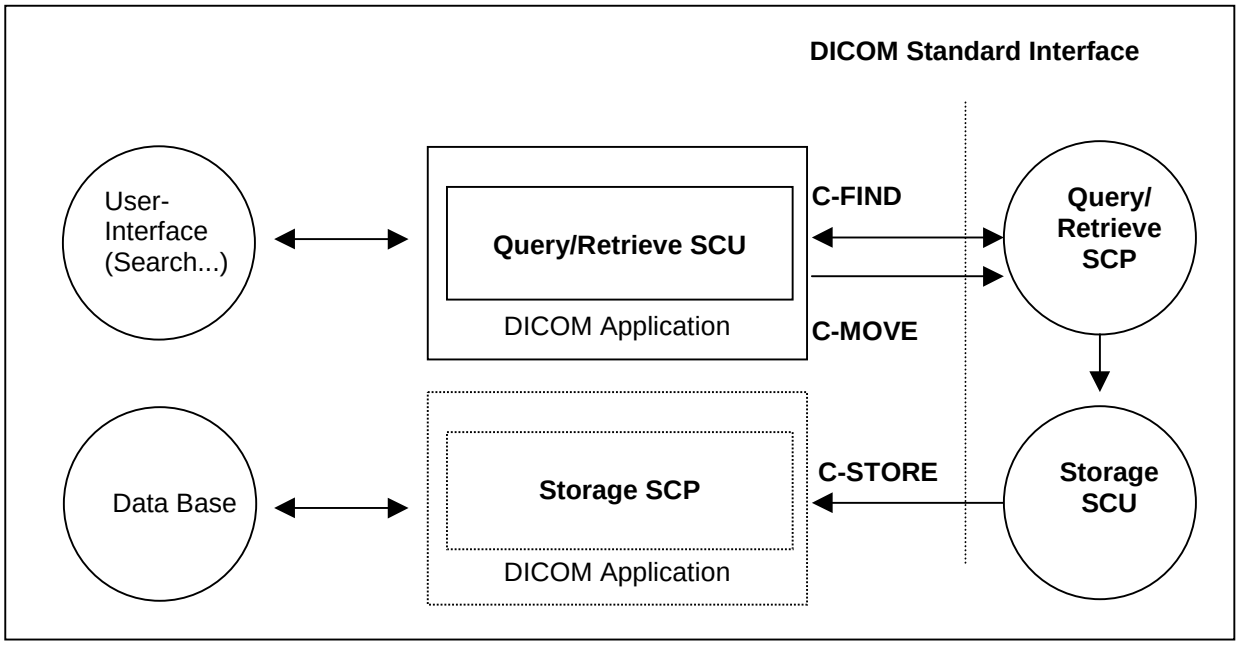


Figure 3: LEONARDO Application Data Flow Diagram – Query/Retrieve SCU

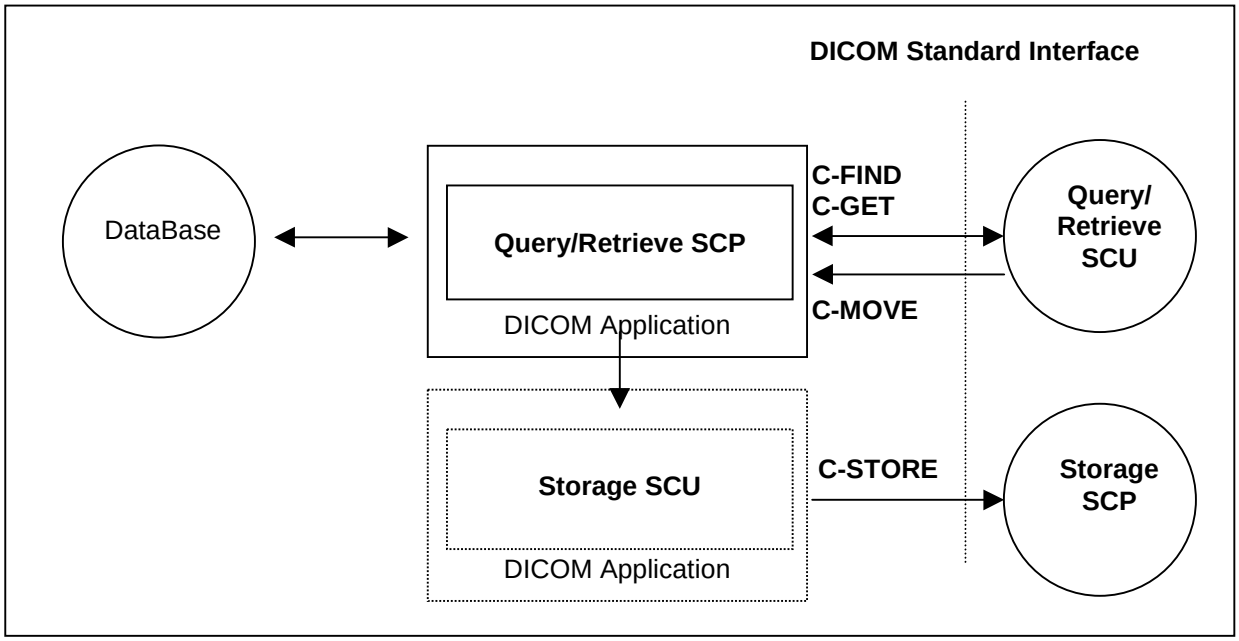


Figure 4: LEONARDO Application Data Flow Diagram – Query/Retrieve SCP

6.2 Functional Definitions of Application Entities

The LEONARDO DICOM query/retrieve SCU requests the remote query/retrieve SCP to perform a search and match to the keys specified in the request in order to display the results in the LEONARDO user interface. Depending on user action (Import) the LEONARDO DICOM SCU sends a C-MOVE DIMSE service to initiate a C-STORE sub-operation on the SCP to start an image transfer from remote Storage SCU (running on Query/Retrieve SCP) to the LEONARDO Storage SCP.

The LEONARDO DICOM query/retrieve SCP responds to C-FIND DIMSE services from remote SCU applications. Depending on further remote request, a C-GET or a C-MOVE involves the Siemens LEONARDO DICOM query/retrieve SCP application to initiate a C-STORE association (by triggering and parametrizing the own Storage SCU) to send image objects to a remote Storage SCP.

All components of the Siemens DICOM query/retrieve SCP application are operating as background server processes. They are existing when the machine is powered on and then respond to queries based on the records stored in its database.

6.3 Sequencing of Real-World Activities

Retrieve of images is only possible if results from a previous “Search...” operation exist and those entities can be selected for “Import”.

7 Application Entity Specification Query/Retrieve

7.1 Query/Retrieve Service AEs Specification

The Query/Retrieve SCU requests that the remote SCP performs a match of all keys specified in the request, against the information in its database and the identified images will be moved over a different (C-MOVE) storage association.

The Query/Retrieve SCP responds to queries based on the records based on its database and images will be sent to the requesting SCU or to a different storage destination.

SIEMENS LEONARDO DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as SCU:

SOP Class Name	SOP Class UID
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2

SIEMENS LEONARDO DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as an SCP:

SOP Class Name	SOP Class UID
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Patient Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.1.3
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Study Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.2.3
Patient/Study Only Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient/Study Only Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2
Patient/Study Only Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.3.3

Note: See also the Storage DICOM Conformance Statement of the Siemens LEONARDO DICOM application to compare for conformance of the C-STORE sub-operation generated by the C-GET or C-MOVE DIMSE services. Furthermore compare the supported Storage Service SOP classes described in the Storage DICOM Conformance Statement of the Modality to which the images shall be transferred to.

7.1.1 Association Establishment Policies

7.1.1.1 General

With the "Search..." function the query data are input and the DICOM query/retrieve application is started. A query request will be sent out to one remote node that can be selected from a list of configured Query Providers and the response data will be displayed for the user. Upon request (Import), the retrieval of selected items is initiated.

The default PDU size used will be 64 KB.

7.1.1.2 Number of Associations

The Siemens LEONARDO DICOM application initiates one association for each query request being processed to a remote node. The max. number of active associations is configurable.

7.1.1.3 Asynchronous Nature

The Siemens LEONARDO DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

7.1.1.4 Implementation Identifying Information

Implementation Class UID	1.3.12.2.1107.5.4.7
Implementation Version Name	“LEONARDO_VA30A"

7.1.2 Association Initiation Policy

The query user interface will request the query-data from user and triggers one C-FIND request to the selected remote node. The response data will be displayed in the query UI for further data navigation.

When requesting Import of related items the browser requests the retrieve application to send a C-MOVE request to the related remote node. Images will then be received by the Storage SCP as described in the related section.

7.1.2.1 Real World Activity - Find SCU

7.1.2.1.1 Associated Real-World Activity - Find SCU

The associated Real-World activity is to fill out a query form with search data and pass it as query to the network application which issues a C-FIND over a previously built association. The remote SCP will respond with related data-entries that will be passed to a browser application. When data transfer is finished the association is closed.

7.1.2.1.2 Proposed Presentation Contexts - Find SCU

The Siemens LEONARDO DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None
Study Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None

It is configurable which of the two query models (or both) are to be used by the LEONARDO DICOM Query SCU application.

7.1.2.1.3 SOP Specific Conformance Statement - Find SCU

The Siemens LEONARDO DICOM Query/Retrieve SCU supports hierarchical queries with all mandatory search keys. The interactive querying of attributes on IMAGE level is not supported by the Query SCU, hence retrieval of individual Objects is possible. The following table describes the search keys for the different query models that the SCU supports

Attribute Name	Tag	Type	Matching	User Input	Return Value Display
Patient Level					
Patient Name[a]	(0010,0010)	R	Wildcard	Enter value	yes
Patient ID[b]	(0010,0020)	U / R	Wildcard	Enter value	yes
Patient´s Birthdate	(0010,0030)	O	Universal(Null)	--	yes
Patient´s Sex	(0010,0040)	O	Universal(Null)	--	yes
Study Level					
Study Instance UID	(0020,000D)	U	Single value	Select from List	--
Study ID	(0020,0010)	R	Universal(Null)	--	--
Study Date	(0008,0020)	R	Universal(Null)	--	yes
Study Time	(0008,0030)	R	Universal(Null)	--	yes
Accession Number	(0008,0050)	R	Universal(Null)	--	yes
Study Description	(0008,1030)	O	Universal(Null)	--	yes
Series Level					
Series Instance UID	(0020,000E)	U	Single Value	Select from List	--
Series Number	(0020,0011)	R	Universal(Null)	--	yes
Modality	(0008,0060)	R	Universal(Null)	--	yes
Series Date	(0008,0021)	O	Universal(Null)	--	yes
Series Time	(0008,0031)	O	Universal(Null)	--	yes
Series Description	(0008,103E)	O	Universal(Null)	--	yes
Image Level					
SOP Instance UID	(0008,0018)	U	Single Value	--	--
Image Number	(0020,0013)	R	Universal(Null)	--	yes

[a] In the Patient Name always a "*" is added
[b] In the Patient ID always a "*" is added

The Find SCU interprets following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources	A700	(0000,0902)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	CXXX	(0000,0901) (0000,0902)
Cancel	Matching terminated due to Cancel request	FE00	None
Success	Matching is complete - No final Identifier is supplied	0000	None
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Identifier
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this identifier	FF01	Identifier

7.1.2.2 Real-World Activity – Move SCU

7.1.2.2.1 Associated Real-World Activity – Move SCU

When selecting a data entry in the Query UI and activate the "Import" function, a retrieval request is passed to the archival application which issues a C-MOVE service according to the Patient Root or Study Root query model. (The Storage Service Class Conformance Statement describes the C-STORE service, which is generated by processing the C-MOVE service.)

The transferred image data are processed as described in the storage class SCP descriptions.

The possibility to request the remote C-MOVE provider (remote application that responded to the C-FIND) to move data to an application entity other that the C-MOVE SCU (the LEONARDO DICOM application) is NOT USED.

7.1.2.2.2 Proposed Presentation Contexts - Move SCU

The Siemens LEONARDO DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None

7.1.2.2.3 SOP Specific Conformance Statement - Move SCU

At association establishment time the C-MOVE presentation context shall be negotiated. The C-STORE sub-operations must be done on a different association to transfer images to the own Storage Service Class SCP.

The Move SCU interprets following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources - Unable to calculate number of matches	A701	(0000,0902)
	Out of Resources - Unable to perform sub operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	CXXX	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete - One or more Failures of Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete - No Failures or Warning	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

7.1.3 Association Acceptance Policy

The Siemens LEONARDO DICOM application will accept associations for the following DIMSE-C operations as SCP:

- C-FIND
- C-GET
- C-MOVE
- C-FIND-CANCEL

Extended negotiation - which is relational retrieve - is NOT supported for the above listed services. The LEONARDO DICOM application does support multiple C-FIND requests over the same association, while multiple C-MOVE or C-GET operations are NOT supported over the same association.

7.1.3.1 Real-World Activity - Find SCP

7.1.3.1.1 Associated Real-World Activity - Find SCP

The associated Real-World activity is to respond query requests to an SCU with the query model Patient Root, Study Root and Patient/Study Only. Relational retrieve operation is NOT supported. With a C-FIND-CANCEL request the running query can be canceled at any time.

Multiple C-FIND requests over the same association are supported.

7.1.3.1.2 Accepted Presentation Contexts - Find SCP

The Siemens LEONARDO DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Patient/Study Only Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

7.1.3.1.3 SOP Specific Conformance Statement - Find SCP

The Siemens LEONARDO DICOM Query/Retrieve SCP supports hierarchical queries with all mandatory and optional search keys. The following table describes the search keys for the four levels of query that the SCP supports.

Attribute Name	Tag	Usage SCU	Matching
Patient Level			
Patient Name	(0010,0010)	R	Single value, Wildcard, universal
Patient ID	(0010,0020)	U (Patient Root, Patient/Study Only) R (Study Root)	Single Value, Wildcard, universal
Patient´s Birth Date	(0010,0030)	O	Single Value, Range, universal
Patient´s Birth Time	(0010,0032)	O	Single Value, Range, universal
Patient´s Sex	(0010,0040)	O	Single Value, Wildcard, universal
Ethnic Group	(0010,2160)	O	Single Value, Wildcard, universal
Patient Comments	(0010,4000)	O	universal
Study Level			
Study Instance UID	(0020,000D)	U	Single Value, List of UID
Study ID	(0020,0010)	R	Single Value, Wildcard, universal
Study Date	(0008,0020)	R	Single Value, Range, universal
Study Time	(0008,0030)	R	Single Value, Range, universal
Accession Number	(0008,0050)	R	Single Value, Wildcard, universal
Referring Physician´s Name	(0008,0090)	O	Single Value, Wildcard, universal
Study Description	(0008,1030)	O	Single Value, Wildcard, universal
Admitting Diagnosis Description	(0008,1080)	O	Single Value, Wildcard, universal
Patient´s Age	(0010,1010)	O	Single Value, Wildcard, universal
Patient´s Size	(0010,1020)	O	Single Value, universal
Patient´s Weight	(0010,1030)	O	Single Value, universal
Occupation	(0010,2180)	O	Single Value, Wildcard, universal
Additional Patient History	(0010,21B0)	O	universal
Series Level			

Attribute Name	Tag	Usage SCU	Matching
Series Instance UID	(0020,000E)	U	Single Value, List of UID
Series Number	(0020,0011)	R	Single Value, Wildcard, universal
Modality	(0008,0060)	R	Single Value, Wildcard, universal
Laterality	(0020,0060)	O	Single Value, Wildcard, universal
Referenced Study Component Sequence	(0008,1111)	O	universal
Body Part Examined	(0018,0015)	O	Single Value, Wildcard, universal
Patient Position	(0018,5100)	O	Single Value, Wildcard, universal
Smallest Pixel Value in Series	(0028,0108)	O	Single Value, universal
Largest Pixel Value in Series	(0028,0109)	O	Single Value, universal
Protocol Name	(0018,1030)	O	Single Value, Wildcard, universal
Series Date	(0008,0021)	O	Single Value, Range, universal
Series Time	(0008,0031)	O	Single Value, Range, universal
Series Description	(0008,103E)	O	Single Value, Wildcard, universal
Image Level			
SOP Instance UID	(0008,0018)	U	Single Value, List of UID
Image Number	(0020,0013)	R	Single Value, universal
Image Date	(0008,0023)	O	Single Value, Range, universal
Image Time	(0008,0033)	O	Single Value, Range, universal

The query attributes contents will be treated case-sensitive.

With wildcard queries the symbol "?" is treated as "*" by the C-FIND SCP application. As a consequence the query string of "?abc*" will be processed as "*abc*".

Usage of Storage Media File-Set ID, Retrieve AE Title with C_FIND_RSP message:

- The Storage Media File-Set ID - if existent - can be returned at Study/Series/Image Level.
- The Retrieve AE Title - if existent - can only be returned at Image Level (for Patient Root and Study Root models) or Study Level (for Patient/Study Only model).

The Find SCP returns following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources	A700	(0000,0902)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	C001	(0000,0901) (0000,0902)
Cancel	Matching terminated due to Cancel request	FE00	None
Success	Matching is complete - No final Identifier is supplied	0000	None
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Identifier
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this identifier	FF01	Identifier

7.1.3.2 Real-World Activity - Get SCP

7.1.3.2.1 Associated Real-World Activity - Get SCP

The associated Real-World activity is to respond to retrieve requests initiated from a foreign SCU. The SCP supports the query model Patient Root, Study Root and Patient/Study Only. The Storage Service Class Conformance Statement describes the C-STORE service which is generated by the C-GET service. Relational retrieve operation is NOT supported.

Multiple C-GET requests over the same association are NOT supported.

7.1.3.2.2 Accepted Presentation Contexts - Get SCP

The Siemens LEONARDO DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.1.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.2.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Patient/Study Only Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

7.1.3.2.3 SOP Specific Conformance Statement - Get SCP

At association establishment time the C-GET presentation context must be negotiated along with the C-STORE sub-operations which must be accomplished on the same association as the C-GET operation. Relational retrieve operation is NOT supported.

The Get SCP returns following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources - Unable to calculate number of matches	A701	(0000,0902)
	Out of Resources - Unable to perform sub operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	C001	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete - One or more Failures of Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete - No Failures or Warning	0000	(0000,1020) (0000,1021)

Service Status	Meaning	Error Codes	Related Fields
			(0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

7.1.3.3 Real-World Activity - Move SCP

7.1.3.3.1 Associated Real-World Activity - Move SCP

The associated Real-World activity is to respond to retrieve requests to an SCU. The SCP supports the query model Patient Root, Study Root and Patient/Study Only. The Storage Service Class Conformance Statement describes the C-STORE service, which is generated by the C-MOVE service. Relational retrieve operation is NOT supported.

Multiple C-MOVE requests over the same association are NOT supported.

7.1.3.3.2 Accepted Presentation Contexts - Move SCP

The Siemens LEONARDO DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Patient/Study Only Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

7.1.3.3.3 SOP Specific Conformance Statement - Move SCP

At association establishment time the C-MOVE presentation context shall be negotiated. The C-STORE sub-operations is done on a different association, specified in the C-MOVE request, to transfer images to a remote SCP of the Storage Service Class. Relational retrieve operation is NOT supported.

The Move SCP returns following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources - Unable to calculate number of matches	A701	(0000,0902)
	Out of Resources - Unable to perform sub operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

Service Status	Meaning	Error Codes	Related Fields
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	C001	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete - One or more Failures of Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete - No Failures or Warning	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

8 Implementation Model Print

The Print Management Service Classes define an application-level class of services, which facilitate the printing of images on a hardcopy medium. The print management SCU and print management SCP are peer DICOM print management application entities. The LEONARDO DICOM print application supports the print management DIMSE services to act as SCU.

8.1 Application Data Flow Diagram

The LEONARDO DICOM network implementation is a Windows NT application and acts as SCU for the print management network service.

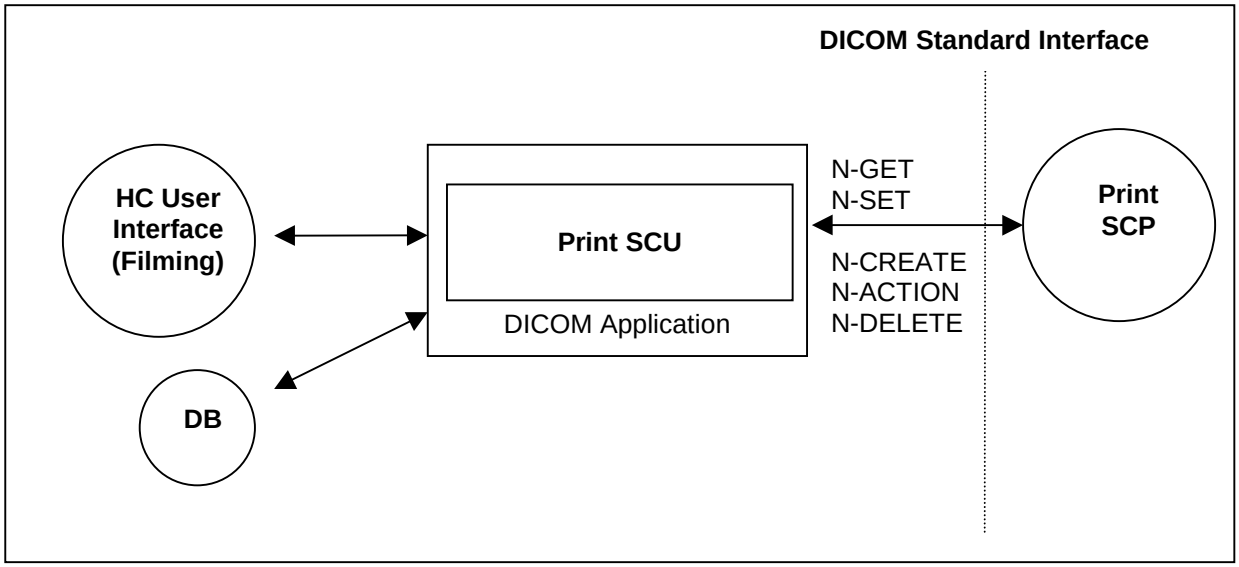


Figure 5: LEONARDO DICOM Application Data Flow Diagram – Print SCU

8.2 Functional Definition of Application Entities

The Print SCU is invoked by the user interface to setup film-sheet layout and whenever an image is ready to be printed on film. The Print SCU will hold and maintain all data needed to compile a complete film-sheet from the data (images, layout, configuration) received. Whenever a film-sheet is ready to print the related data is used to supply the Information to the SOP Classes of the Print Management Service Class. A queue is maintained, in order to intermediately store several film-sheets in case of resource problems on printer. The SCU will only supply and require the mandatory SOP Classes of the Print Management Service Class.

8.3 Sequencing of Real-World Activities

Not applicable

9 Application Entity Specification Print

9.1 Print Management AE Specification

The LEONARDO print management SCU (HCS) invokes print management DIMSE services to transfer images from the local AE to the remote SCP AE to print images with defined layout on a selected network-based DICOM hardcopy printer. This is done in an "full-page" print mode.

SIEMENS LEONARDO DICOM products provide Standard Conformance to the following DICOM V3.0 Print Management Meta SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
- Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
- Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
- Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
- Printer SOP Class	1.2.840.10008.5.1.1.16
Print Job SOP Class	1.2.840.10008.5.1.1.14

SOP Class Name	SOP Class UID
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18
- Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
- Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
- Basic Color Image Box SOP Class	1.2.840.10008.5.1.1.4.1
- Printer SOP Class	1.2.840.10008.5.1.1.16
Print Job SOP Class	1.2.840.10008.5.1.1.14

9.1.1 Association Establishment Policies

9.1.1.1 General

Whenever a film is completely set up and printed by command or automatism the job is prepared for processing. As soon as the queue is ready to process the job is activated and worked according the processing data. The related Print application will initiate an association to the print destination and process the printing of the related information.

The default PDU size used will be 64 KB.

9.1.1.2 Number of Associations

The Siemens LEONARDO DICOM application initiates one association at a time for each different print device configured.

9.1.1.3 Asynchronous Nature

The Siemens LEONARDO DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

9.1.1.4 Implementation Identifying Information

Implementation Class UID	1.3.12.2.1107.5.4.7
Implementation Version Name	“LEONARDO_VA30A”

9.1.2 Association Initiation Policy

Triggered by the Print job queue the Print Management SCU establishes an association by using the DICOM association services. With the help of the N-GET request for the Printer SOP Class the Status is determined before printing.

With no problem encountered with the N-CREATE/N-SET Services for the related Basic Print SOP Classes the film sheet is set up for printing and the image(s) is(are) transferred to the printer device.

After the last film is printed from queue, the Print application will leave open the association for another 60 seconds. If a new film job is ready for printing within this time-limit, the job will be immediately processed over the still open association. If there is no new job, the association is closed if the time-out elapsed. This done to optimize automated printing.

During the "idle-time" (no open association to printer) the Print application will issue a cyclic camera status request (using N-GET of Printer SOP Class) every 5 minutes.

9.1.2.1 Associated Real-World Activity

9.1.2.1.1 Associated Real-World Activity - Printing a Printer Job Queue Entry

Whenever a film-sheet is prepared by the user, it is forwarded to the Printer Job queue. As soon as the associated Printer device is available the job is activated and association is set up.

The film sheet is internally processed, converted to a Standard/1-1 page and then the page image is sent. Status is controlled by awaiting any N-EVENT message all through the transfer until the last image or film-sheet is sent.

If the response from the remote application contains a status other than Success or Warning the association is aborted.

9.1.2.1.2 Proposed Presentation Context (Presentation Context Table)

The Siemens LEONARDO DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Basic Grayscale Print Management Meta SOP class	1.2.840.10008.5.1.1.9	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Basic Color Print Management Meta SOP class	1.2.840.10008.5.1.1.18	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Basic film session SOP class	1.2.840.10008.5.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Basic Film Box SOP class	1.2.840.10008.5.1.1.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Basic Grayscale Image Box SOP class	1.2.840.10008.5.1.1.4	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Basic Color Image Box SOP class	1.2.840.10008.5.1.1.4.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Printer SOP class	1.2.840.10008.5.1.1.16	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Print Job SOP class	1.2.840.10008.5.1.1.14	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

9.1.2.1.3 SOP specific Conformance Statement – Meta SOP Classes

The Siemens LEONARDO DICOM print management SCU conforms to the DICOM Basic Grayscale Print Management Meta SOP Class and the Basic Color Print Management Meta SOP Class.

The application uses a setting platform to define the properties of the connected DICOM SCP, e.g.:

- maximum number of print jobs in the queue
- maximum number of print copies
- supported film sizes of the connected DICOM SCP
- supported film formats of the DICOM SCP
- lookup table definition.

The printing is only suspended in the case of a failure return status of the SCP.

9.1.2.1.3.1 Basic Film Session SOP class

The Basic Film Session information object definition describes all the user defined parameter which are common for all the films of a film session. The Basic Film Session refers to one or more Basic Film Boxes and that are printed on one hardcopy printer.

The LEONARDO DICOM print management SCU supports the following DIMSE Service elements for the Basic Film Session SOP Class as SCU:

- N-CREATE
- N-DELETE

The Basic Film Session SOP Class N-CREATE-RQ (SCU) uses the following attributes:

Attribute Name	Tag	Usage SCU	Supported Values
Number of Copies	(2000,0010)	U	
Medium Type	(2000,0030)	U	BLUE FILM CLEAR FILM PAPER
Film Destination	(2000,0040)	U	MAGAZINE PROCESSOR

The affected SOP Instance UID received with N-CREATE-RSP message will be kept internally and used for later requests (e.g. N-DELETE-RQ) on the Basic Film Session - see below:

Attribute Name	Tag	Source of Information
Requested SOP Instance UID	(0000,1000) → (0000,1001)	Affected SOP Instance UID of N-CREATE-RSP on Basic Film Session

The N-DELETE-RQ on the Basic Film Session SOP Class is used to remove the complete Basic Film Session SOP Instance hierarchy.

The Basic Film Session SOP class interprets the following status codes (from N-CREATE-RSP, N-DELETE-RSP messages):

Service Status	Meaning	Error Codes
Failed	Film session SOP instances hierarchy does not contain film box SOP instances	C600
	Unable to create print job, print queue is full	C601
	Image size is larger than images box size	C603
Warning	Memory allocation not supported	B600
	Film session printing is not supported	B601
	Film box does not contain image box (empty page)	B602
Success	Film belonging to the film session are accepted for printing	0000

9.1.2.1.3.2 Basic Film Box SOP class

The Basic Film Box information object definition describes all the user-defined parameter of one film of the film session. The Basic Film Box information description defines the presentation parameters, which are common for all images on a given sheet of film.

The Basic Film Box refers to one or more Image Boxes.

Supported Service Elements as SCU are:

- N-CREATE
- N-ACTION
- N-DELETE

The Basic Film Box SOP class N-CREATE-RQ message uses the following attributes (the actual values for each attribute depend on DICOM printer configuration within the LEONARDO DICOM print management SCU):

Attribute Name	Tag	Usage SCU	Supported Values
Image Display Format	(2010,0010)	M	STANDARD\1,1
Referenced Film Session Sequence	(2010,0500)	M	
> Referenced SOP Class UID	(0008,1150)	M	1.2.840.10008.5.1.1.1
> Referenced SOP Instance UID	(0008,1155)	M	
Film Orientation	(2010,0040)	M	PORTRAIT
Film Size ID	(2010,0050)	M	8INX10IN, 10INX12IN, 10INX14IN, 11INX14IN,, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM
Magnification Type	(2010,0060)	M	BILINEAR, CUBIC, NONE, REPLICATE
Max Density	(2010,0130)	U	
Min Density	(2010,0120)	U	

The N-CREATE-RSP message from the Print SCP includes the Referenced Image Box Sequence with SOP Class/Instance UID pairs which will be kept internally to be further used for the subsequent Basic Image Box SOP Class N-SET-RQ messages.

When all Image Boxes (including parameters) for the film-sheet have been set, the LEONARDO DICOM print manager will issue a N-ACTION-RQ message with the SOP Instance UID of the Basic Film Box and the Action Type ID of 1.

The affected SOP Instance UID received with N-CREATE-RSP message will be kept internally and used for later requests (e.g. N-DELETE-RQ) on the Basic Film Box - see below:

Attribute Name	Tag	Source of Information
Requested SOP Instance UID	(0000,1000) → (0000,1001)	Affected SOP Instance UID of N-CREATE-RSP on Basic Film Box

The Basic Film Box SOP class interprets the following status codes:

Service Status	Meaning	Error Codes
Failure	Unable to create print job, print queue is full	C601
	Image size is larger than images box size	C603
Warning	Film box does not contain image box (empty page)	B603
	Requested MinDensity or MaxDensity outside of Printer's operating range	B605
Success	Film accepted for printing	0000

9.1.2.1.3.3 Basic Grayscale Image Box SOP Class

The Basic Grayscale Image Box information object definition is the presentation of an image and image related data in the image area of a film. The Basic Image Box information describes the presentation parameters and image pixel data, which apply to a single image of a sheet of film.

The Grayscale Image Box SOP Class uses only the N-SET-RQ with the following attributes:

Attribute Name	Tag	Usage SCU	Supported Values
Image Position	(2020,0010)	M	1
BASIC Grayscale Image Sequence	(2020,0110)	M	
> Samples per Pixel	(0028,0002)	M	1
> Photometric Interpretation	(0028,0004)	M	MONOCHROME2
> Rows	(0028,0010)	M	
> Columns	(0028,0011)	M	
> Pixel Aspect Ratio	(0028,0034)	M	
> Bits Allocated	(0028,0100)	M	8
> Bits Stored	(0028,0101)	M	8
> High Bit	(0028,0102)	M	7
> Pixel Representation	(0028,0103)	M	0
> Pixel Data	(7FE0,0010)	M	

The Grayscale Image Box SOP class interpret the following status codes:

Service Status	Meaning	Error Codes
Failure	Image contains more pixel than printer can print in Image Box	C603
	Insufficient memory in printer to store the image	C605
Warning	Requested MinDensity or MaxDensity outside of Printer's operating range	B605
Success		0000

9.1.2.1.3.4 Basic Color Image Box SOP Class

The Basic Color Image Box information object definition is the presentation of an image and image related data in the image area of a film. The Basic Image Box information describes the presentation parameters and image pixel data, which apply to a single image of a sheet of film.

The Color Image Box SOP Class uses only the N-SET-RQ with the following attributes:

Attribute Name	Tag	Usage SCU	Supported Values
Image Position	(2020,0010)	M	1
BASIC Color Image Sequence	(2020,0111)	M	
> Samples per Pixel	(0028,0002)	M	3
> Photometric Interpretation	(0028,0004)	M	RGB
> Planar Configuration	(0028,0006)	M	0
> Rows	(0028,0010)	M	
> Columns	(0028,0011)	M	
> Pixel Aspect Ratio	(0028,0034)	M	
> Bits Allocated	(0028,0100)	M	8
> Bits Stored	(0028,0101)	M	8
> High Bit	(0028,0102)	M	7
> Pixel Representation	(0028,0103)	M	0
> Pixel Data	(7FE0,0010)	M	

The Color Image Box SOP class interpret the following status codes:

Service Status	Meaning	Error Codes
Failure	Image contains more pixel than printer can print in Image Box	C603

Service Status	Meaning	Error Codes
	Insufficient memory in printer to store the image	C605
Warning	Image size larger than image box size	B604
Success		0000

9.1.2.1.3.5 Printer SOP Class

The Printer SOP Class is the possibility to monitor the status of the hardcopy printer in a synchronous and an asynchronous way.

The SCU uses the mandatory N-EVENT Report DIMSE service to monitor the changes of the printer status in an asynchronous way.

It can directly ask the Printer (SCP) for its status or receive Events from the Printer asynchronously:

- N-GET as SCU
- N-EVENT-REPORT as SCU

In both cases the following information is supported:

Used Printer N-EVENT Report attributes

Event-type Name	Event	Attributes	Tag	Usage SCU
Normal	1			
Warning	2	Printer Status Info	(2110,0020)	U
Failure	3	Printer Status Info	(2110,0020)	U

Mandatory Printer N-GET-RSP, N-EVENT-REPORT-RQ attributes

Attribute Name	Tag	Usage SCP	Supported Values
Printer Status	(2110,0010)	M	NORMAL, FAILURE, WARNING
Printer Status Info	(2110,0020)	M	SUPPLY EMPTY[a], SUPPLY LOW, RECEIVER FULL, NO RECEIVE MGZ, FILM JAM

9.1.2.1.3.6 Print Job SOP Class

The Print Job SOP Class is the possibility to monitor the execution of the print process.

The LEONARDO DICOM Print Management application supports the optional N-EVENT-REPORT DICMSE Service to receive the changes of the Print Job Status in an asynchronous way.

It can receive Events from the Print SCP asynchronously:

- N-EVENT-REPORT

The following information is supported:

Used Print Job N-EVENT Report attributes

Event-type Name	Event	Attributes	Tag	Usage SCU
Normal	1	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U

[a] Only valid in case of Printer Status WARNING

Event-type Name	Event	Attributes	Tag	Usage SCU
		Printer Name	(2110,0030)	U
Printing	2	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U
		Printer Name	(2110,0030)	U
Done	3	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U
		Printer Name	(2110,0030)	U
Failure	4	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U
		Printer Name	(2110,0030)	U

9.1.3 Association Acceptance Policy

Not applicable

10 Communication Profiles

10.1 Supported Communication Stacks

The Siemens LEONARDO DICOM application provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

10.1.1 OSI Stack

Not supported

10.1.2 TCP/IP Stack

The Siemens LEONARDO DICOM application uses the TCP/IP stack from the Windows NT system upon which it executes. It uses the MergeCOM-3 subroutine library from Merge Technologies Inc. that is based on a Berkeley socket interface.

10.1.2.1 API

The Siemens LEONARDO DICOM application uses the MergeCOM library that is based on a TCP/IP socket interface.

10.1.2.2 Physical Media Support

The Siemens LEONARDO DICOM application is indifferent to the physical medium over which TCP/IP executes; it inherits this from the Windows NT system upon which it executes.

10.1.3 Point-to-Point Stack

Not supported

11 Extensions / Specializations / Privatizations

11.1.1 Standard Extended / Specialized / Private SOPs

Please refer to Appendix for all information on these topics. A detailed overview is given there.

11.1.2 Private Transfer Syntaxes

Not applicable

12 Configuration

12.1 AE Title/Presentation Address Mapping

To ensure unique identification within the network the hostname should be used as part of the AE Titles (see examples below, hostname = axwsca1). The string can be up to 16 characters long and must not contain any extended characters, only 7-bit ASCII characters (excluding Control Characters) are allowed according to DICOM Standard.

12.1.1 DICOM Verification

The Verification Service uses the AE configuration of the DICOM Service that is checked with the C-ECHO message. e.g. Verification will use the Storage AE, if initiated to check the configuration of a remote DICOM node.

12.1.2 DICOM Storage AE Title

The DICOM Storage application provides the application entity title, which can be configured via Service UI:

e.g. STU_AXWSCA1

The port number is set to the fixed value of

104

12.1.3 DICOM Query/Retrieve AE Title

The DICOM Query/Retrieve application uses the same application entity title as the DICOM Storage AE.

12.1.4 DICOM Print AE Title

The DICOM Print application provides the application entity title:

e.g. PRI_AXWSCA1 *(No input of AETs starting with a numeric character is possible)*

The port number is set to the fixed value of

108

12.2 Configurable Parameters

The Application Entity Titles, host names and port numbers are configured using the Siemens LEONARDO Service/Installation Tool. For each AET the list of services supported can be configured.

12.2.1 Storage and Query/Retrieve

The Siemens LEONARDO Service/Installation Tool can be used to set the AET's, port-numbers, host-names, IP-addresses and capabilities for the remote nodes (SCP's). The user can select transfer syntaxes, compression modes and query models for each SCP separately.

12.2.2 Print

The Siemens LEONARDO Service/Installation Tool can be used to configure the SCP (DICOM-Printer). The AET, host-name, IP-address and port-number can be set.

12.3 Default Parameters

This installation tool also uses some default parameters:

- max PDU size set to 65536 Bytes (64 kB)
- time-out for accepting/rejecting an association request: 240 s
- time-out for responding to an association open/close request: 240 s
- time-out for accepting a message over network: 240 s
- time-out for waiting for data between TCP/IP-packets: 240 s

The time-outs for waiting for a Service Request/Response message from the remote node are as follows:

- for Storage SCP/SCU: 600 s
- for Query/Retrieve SCP/SCU: 600 s
- for Print Management SCU:
  - time-out for Response to N-SET-RQ: 240 s
  - time-out for Response to other Requests: 60 s

13 Support of Extended Character Sets

The Siemens LEONARDO DICOM application supports the ISO 8859 Latin 1 (ISO-IR 100) character set.

Also the Japanese language character sets JIS X 0201 (ISO-IR 13 Japanese katakana and ISO-IR 14 Japanese romaji), JIS X 0208 (ISO-IR 87 Japanese kanji) and JIS X 0212 (IOS-IR 159 Supplementary Japanese kanji) are supported.

LEONARDO Offline Media Application Profile

Will contain an LEONARDO specific Application Profile.

Structure of this Application Profile is defined in Part 11 of the 1998 DICOM Standard.

It is needed to describe the requirements for Offline Media Storage of the private IOD (Non-Image IOD).

1 Class and Profile Identification

Class and Profile Identification

This document defines an Application Profile Class for Universal X-Ray Modular Angiographic / Radiographic applications.

The identifier for this class shall be PRI-XAMAS. This class is intended to be used for interchange of extended and private Information Objects via CD-R or re-writeable magneto-optical disk (MOD) offline media between dedicated Angiography, Neuro-Radiology, Radiography applications build from a common architecture.

The specific application profiles in this class are shown in Table 1:

Application Profile	Identifier	Description
Universal X-Ray Modular Angio/ Radio System on CD-R	PRI-XAMAS-CD	Handles interchange of Composite SOP Instances and privately defined SOP Instances (Dose Reports, Object Graphics, Quantification Results and more).
Universal X-Ray Modular Angio/ Radio System on 2.3 GB MOD	PRI-XAMAS-MOD23	Handles interchange of Composite SOP Instances and privately defined SOP Instances (Dose Reports, Object Graphics, Quantification Results and more).
Universal X-Ray Modular Angio/ Radio System on 4.1 GB MOD[a]	PRI-XAMAS-MOD41	Handles interchange of Composite SOP Instances and privately defined SOP Instances (Dose Reports, Object Graphics, Quantification Results and more).

Equipment claiming conformance for this Universal X-Ray Modular Angio/Radio System shall make a clear statement on handling of the private defined SOP Instances.

2 Clinical Context

This application profile facilitates the interchange of X-Ray acquisition and derived images and private data related to them. Typical media interchange would be from in-lab acquisition equipment to dedicated angio workstations and archive systems with specific extensions to handle the private data objects (in both directions).

Additionally, images (from MR, CT, US) used to prepare interventional procedures, multi-modality images (e.g. integrated US) and images derived from primary X-Ray images, such as annotations, quantitative analysis images, reference images, screen capture images may be interchanged via this profile.

2.1 Roles and Service Class Options

This Application Profile uses the Media Storage Service Class defined in PS 3.4 with the Interchange Option.

The Application Entity shall support one or more of the roles of File Set Creator (FSC), File Set Reader (FSR), and File Set Updater (FSU), defined in PS 3.10.

2.1.1 File Set Creator

The Application Entity acting as a File-Set Creator generates a File Set under the PRI-XAMAS-CD Application Profile.

[a] Definition of this profile is done under the impression that pending CP195 makes additions to PS3.12 for support of this physical medium.

File Set Creators shall be able to generate the Basic Directory SOP Class in the DICOMDIR file with all the subsidiary Directory Records related to the Image SOP Classes and Private SOP Classes stored in the File Set.

In case of the PRI-XAMAS-CD profile, the FSC shall offer the ability to either finalize the disc at the completion of the most recent write session (no additional information can be subsequently added to the disc) or to allow multi-session (additional information may be subsequently added to the disc).

Note

A multiple volume (a logical volume that can cross multiple physical media) is not supported by this Application Profile Class. If a set of Files, e.g., a Study, cannot be written entirely on one CD-R, the FSC will create multiple independent DICOM File-Set such that each File-Set can reside on a single CD-R medium controlled by its individual DICOMDIR file. The user of the FSC can opt to use written labels on the discs to reflect that there is more than one disc for this set of files (e.g., a Study).

2.1.2 File Set Reader

The role of the File Set Reader shall be used by Application Entities which receive the transferred File Set.

File Set Readers shall be able to read all the defined SOP Instances files defined for the specific Application Profiles to which a conformance claim is made, using all the defined Transfer Syntaxes.

2.1.3 File Set Updater

The role of the File Set Updater shall be used by Application Entities, which receive a transferred File Set and update it by the addition of processed information.

File Set Updaters shall be able to read and update the DICOMDIR file. File-Set Updaters do not have to read the image/private information objects. File-Set Updaters shall be able to generate any of the SOP Instances files defined for the specific Application Profiles to which a conformance claim is made, and to read and update the DICOMDIR file.

In case of the PRI-XAMAS-CD profile, the FSU shall offer the ability to either finalize a disc at the completion of the most recent write session (no additional information can be subsequently added to the disc) or to allow multi-session (additional information may be subsequently added to the disc).

Note (for CD-R)

If the disc has not been finalized, the File-Set Updater will be able to update information assuming there is enough space on the disc to write a new DICOMDIR file, the information, and the fundamental CD-R control structures. CD-R control structures are the structures that inherent to the CD-R standards; see PS 3.12

3 PRI-XAMAS Profiles

3.1 SOP Classes and transfer Syntaxes

These Application Profiles are based on the Media Storage Service Class with the Interchange Option.

Information Object Definition	SOP Class UID	Transfer Syntax UID	FSC	FSR	FSU
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	M
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	M	M	O
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	M	O
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	M	M	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	M	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
CR Image	1.2.840.10008.5.1.4.1.1.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
CR Image	1.2.840.10008.5.1.4.1.1.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
CR Image	1.2.840.10008.5.1.4.1.1.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
CR Image	1.2.840.10008.5.1.4.1.1.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
CT image	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
CT Image	1.2.840.10008.5.1.4.1.1.2	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O

Information Object Definition	SOP Class UID	Transfer Syntax UID	FSC	FSR	FSU
CT Image	1.2.840.10008.5.1.4.1.1.2	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
CT Image	1.2.840.10008.5.1.4.1.1.2	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
MR Image	1.2.840.10008.5.1.4.1.1.4	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
MR Image	1.2.840.10008.5.1.4.1.1.4	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
MR Image	1.2.840.10008.5.1.4.1.1.4	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
MR Image	1.2.840.10008.5.1.4.1.1.4	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
NM Image	1.2.840.10008.5.1.4.1.1.20	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
NM Image	1.2.840.10008.5.1.4.1.1.20	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
NM Image	1.2.840.10008.5.1.4.1.1.20	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
NM Image	1.2.840.10008.5.1.4.1.1.20	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
CSA Non-Image	1.3.12.2.1107.5.9.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	M	O
Detached Patient Management	1.2.840.10008.3.1.2.1.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	see DCS	O

FSC, FSR, FSU – denote the requirements for those roles
O – Optional
M - Mandatory

3.2 Physical Media and Formats

The PRI-XAMAS-CD Profile requires the 120mm CD-R physical media with the ISO/IEC 9660 Media Format, as defined in PS3.12.

The PRI-XAMAS-MOD23 Profile requires the 130mm 2.3 GB R/W MOD physical medium with the PCDOS Media Format, as defined in PS3.12.

The PRI-XAMAS-MOD41 Profile requires the 130mm 4.1 GB R/W MOD physical medium with the PCDOS Media Format, as proposed by pending DICOM CP 195.

3.3 Directory Information in DICOMDIR

Conforming Application Entities shall include in the DICOMDIR File the Basic Directory IOD containing Directory Records at the Patient and subsidiary levels appropriate to the SOP Classes in the File-set. All DICOM files in the File-set incorporating SOP Instances defined for the specific Application profile, shall be referenced by Directory Records.

Note

DICOMDIRs with no directory information are not allowed by this Application Profile

Privately defined IODs will be referenced by "PRIVATE" Directory Records.

3.3.1 Basic Directory IOD Specialization

This Application Profile makes use of optional attributes of the Basic Directory IOD to support recognition of Patient's Storage Service request results in spanning multiple volumes (file sets). Therefore the File Set Descriptor File can be used and is then referenced by optional Basic Directory IOD attributes. If existent, the specified Descriptor File may be used by FSR applications. Any FSU, FSC shall make a clear Statement if the Descriptor File mechanism is used according to the specialization defined in this Application Profile.

The Descriptor Files shall have the following contents:

One single Line without any control-characters and according to the Basic Character-Set having the following defined text:

"MULTIVOLUME: xx of yy"

xx, yy are replaced by the actual Number of the volume (xx) and the Total Number of Volumes in the set (yy).

If used, the Descriptor File shall have the File ID "README" and reside in same directory level as the DICOMDIR. It is referenced by the attribute [0004,1141] File-set Descriptor File ID having the defined content of "README".

3.3.2 Additional Keys

File-set Creators and Updaters are required to generate the mandatory elements specified in PS 3.3, Annex F of the DICOM Standard. Table 3:PRI-XAMAS-CD Additional DICOMDIR Keys specifies the additional associated keys. At each directory record level other additional data elements can be added, but it is not required that File Set Readers be able to use them as keys. Refer to the Basic Directory IOD in PS 3.3.

Key Attribute	Tag	Directory Record Level	Type	Notes
Date of Birth	(0010,0030)	PATIENT	2C	required, if present in SOP Instance
Patient´s Sex	(0010,0040)	PATIENT	2C	required, if present in SOP Instance
Series Date	(0008,0021)	SERIES	3	
Series Time	(0008,0031)	SERIES	3	
Institute Name	(0008,0080)	SERIES	2C	required, if present in SOP Instance
Institution Address	(0008,0081)	SERIES	2C	required, if present in SOP Instance
Series Description	(0008,103E)	SERIES	3	
Performing Physician´s Name	(0008,1050)	SERIES	2C	required, if present in SOP Instance
Image Type	(0008,0008)	IMAGE	1C	required, if present in SOP Instance
SOP Class UID	(0008,0016)	IMAGE	3	
SOP Instance UID	(0008,0018)	IMAGE	3	
Image Date	(0008,0023)	IMAGE	3	
Image Time	(0008,0033)	IMAGE	3	
Referenced Image Sequence	(0008,1140)	IMAGE	1C	required, if present in SOP Instance
> Referenced SOP Class UID	(0008,1150)			
> Referenced SOP Instance UID	(0008,1155)			
Image Position (Patient)	(0020,0032)	IMAGE	2C	required, if present in SOP Instance
Image Orientation (Patient)	(0020,0037)	IMAGE	2C	required, if present in SOP Instance
Frame of Reference UID	(0020,0052)	IMAGE	2C	required, if present in SOP Instance
Rows	(0028,0010)	IMAGE	3	
Columns	(0028,0011)	IMAGE	3	
Pixel Spacing	(0028,0030)	IMAGE	1C	required, if present in SOP Instance
Calibration Image	(0050,0004)	IMAGE	2C	required, if present in SOP Instance
Icon Image Sequence	(0088,0200)	IMAGE	3	Required for XA SOP Class
> Samples per Pixel	(0028,0002)			1
> Photometric Interpretation	(0028,0004)			MONOCHROME2
> Rows	(0028,0010)			128 for XA, 64 for others
> Columns	(0028,0011)			128 for XA, 64 for others
> Bits Allocated	(0028,0100)			8
> Bits Stored	(0028,0101)			8
> High Bit	(0028,0102)			7
> Pixel Representation	(0028,0103)			0
> Pixel Data	(7FE0,0010)			Icon Image

3.3.3 Private Directory Record Keys

Private Directory Records are supported by this Application Profile Class at the following Level - IMAGE. The PRIVATE Directory Records will have required elements in addition to the mandatory elements specified in PS 3.3.

The following table will list the additional required keys for PRIVATE Directory Records:

Key Attribute	Tag	Directory Record Level	Type	Notes
Private Record UID	(0004,1432)	PRIVATE	1	See Conformance Statement
SOP Class UID	(0008,0016)	PRIVATE	1C	required, if present in SOP Instance
SOP Instance UID	(0008,0018)	PRIVATE	1C	required, if present in SOP Instance
Image Type	(0008,0008)	PRIVATE	3	
Acquisition Date	(0008,0022)	PRIVATE	3	
Acquisition Time	(0008,0032)	PRIVATE	3	
Acquisition Number	(0020,0012)	PRIVATE	3	

Key Attribute	Tag	Directory Record Level	Type	Notes
CSA Data Type	(0029,xx08)	PRIVATE	1	private owner code = SIEMENS CSA NON-IMAGE
CSA Data Version	(0029,xx09)	PRIVATE	3	private owner code = SIEMENS CSA NON-IMAGE

3.3.4 Icon Images

Directory Records of type SERIES or IMAGE may include Icon Images. The Icon Image pixel data shall be as specified in PS 3.3 "Icon Image Key Definition", and restricted such, that Bits Allocated (0028,0100) and Bits Stored (0028,0101) shall be equal 8, and Rows (0028,0010) and Columns (0028,0011) shall be equal to 128 for XA Images and 64 for all other Images. The Photometric Interpretation (0028,0004) shall always be restricted to "MONOCHROME2".

PRIVATE Directory Records will not contain Icon Image information.

3.4 Other Parameters

This section defines other parameters common to all specific Application Profiles in the PRI-XAMAS class which need to be specified in order to ensure interoperable media interchange.

3.4.1 Multi-Frame JPEG Format

The JPEG encoding of pixel data shall use Interchange Format (with table specification) for all frames.

3.4.2 Attribute Value Precedence

The values of attributes contained in a Detached Patient Management SOP Instance referenced by a DICOMDIR PATIENT Directory Record shall take precedence over the values of those attributes contained in the SOP Instance referenced by a subsidiary Directory Record. The DICOMDIR Directory Records shall have key attribute values in accordance with this precedence.

Note

This allows patient identification and demographic information to be updated without changing the composite Image IOD files. The DICOMDIR file thus is critical in establishing the link between the updated information and the image. As an example, at the time an Image file was written, the patient's name therein was incorrect, or inconsistent with the Hospital Information System records. Subsequently, a Detached Patient Management file with the corrected name is added to the file-set. The FSR should use the name from the Patient File rather than in the Image File.

Application Profile Conformance Statement

This chapter will contain the Conformance Statement to all "Offline Media Application Profiles (incl. private extentions)" supported by the LEONARDO archive options.

Those application profiles supported shall be:

- Basic Cardiac
- 1024 Extended Cardiac
- General Purpose CDR
- M.A.S. private Application Profile

1 Introduction

1.1 Purpose

This DICOM Conformance Statement is written according to part PS 3.2 of [1].

The applications described in this conformance statement are the SIEMENS Angiographic/Radiographic Workstation (LEONARDO) based products using the LEONARDO software. The LEONARDO DICOM offline media storage service implementation acts as FSC, FSU and/or FSR for the specified application profiles and the related SOP Class instances.

1.2 Scope

This DICOM Conformance Statement refers to SIEMENS LEONARDO based products using LEONARDO software. The following table relates LEONARDO software names to SIEMENS products:

Software Name	SIEMENS LEONARDO Product
VA30A	LEONARDO DR / DSA

1.3 Definitions, Abbreviations

1.3.1 Definitions

DICOM Digital Imaging and Communications in Medicine
DIMSE DICOM Message Service Element
DIMSE-C DICOM Message Service Element with Composite information objects

1.3.2 Abbreviations

ACR American College of Radiology
AE DICOM Application Entity
ASCII American Standard Code for Information Interchange
LEONARDO AX-Workstation (for Angiographic/Radiographic viewing)
DB Database
DCS DICOM Conformance Statement
FSC File Set Creator
FSR File Set Reader
FSU File Set Updater
IOD DICOM Information Object Definition
ISO International Standard Organization
MOD Magneto-optical Disk
NEMA National Electrical Manufacturers Association
O Optional Key Attribute
PDU DICOM Protocol Data Unit
R Required Key Attribute
RWA Real-World Activity
U Unique Key Attribute

1.4 References

[1] Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-12, 1999

1.5 Remarks

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality as SCU and SCP, respectively.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.

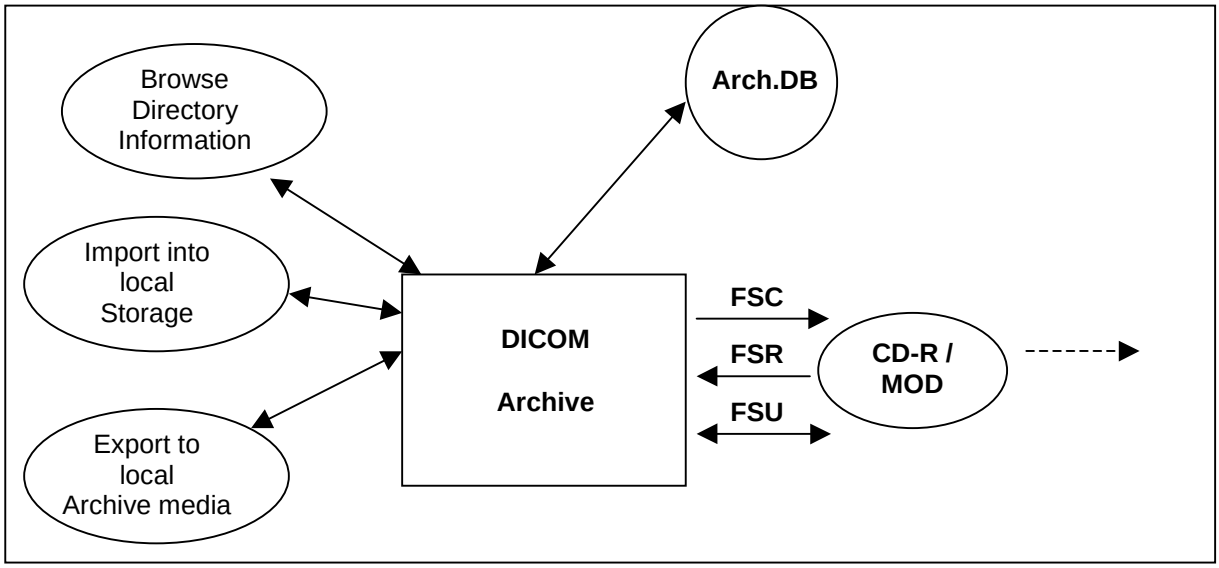
The scope of this Conformance Statement is to facilitate communication with Siemens and other vendors' Medical equipment. The Conformance Statement should be read and understood in conjunction with the DICOM 3.0 Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

- The comparison of different conformance statements is the first step towards assessing interconnectivity between Siemens and non-Siemens equipment.
- Test procedures should be defined and tests should be performed by the user to validate the connectivity desired. DICOM itself and the conformance parts do not specify this.
- The standard will evolve to meet the users' future requirements. Siemens is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.
- Siemens reserves the right to modify the design and specifications contained herein without prior notice. Please contact your local Siemens representative for the most recent product information.

2 Implementation Model

2.1 Application Data Flow Diagram



The DICOM archive application will serve as an interface to the CD-R offline medium device. It serves interfaces to include the offline media directory into the browser and to copy SOP instances to a medium or retrieve SOP Instances from medium into local storage.

The DICOM Archive application will support the 120mm CD-R medium, the 130mm 2.3 GB R/W MOD and the 130mm 4.1[a] GB R/W MOD.

The FSU role will update new SOP Instances only to media with pre-existing File-sets conforming to the Application Profiles supported.

The contents of the DICOMDIR will be temporarily stored in Archive-Database.

2.2 Functional Definitions of AEs

The LEONARDO DICOM offline media storage application consists of the DICOM Archive application entity serving all interfaces to access offline media. The DICOM Archive application is capable of

1. creating a new File-set onto an unwritten medium (Export to…).
2. updating an existing File-set by writing new SOP Instances onto the medium (Export to...).
3. importing SOP Instances from the medium onto local storage
4. reading the File-sets DICOMDIR information into temporary database and pass it to display applications.

2.3 Sequencing of Real-World Activities

Not applicable.

[a] the 4.1 GB is not yet defined in PS3.12, but necessary additions are due to pending DICOM Change Proposal (CP) #195.

2.4 File Meta Information Options

Implementation Class UID	1.3.12.2.1107.5.4.7
Implementation Version Name	“LEONARDO_VA30A”

3 AE Specifications

3.1 DICOM Archive Specification

The DICOM Archive provides Standard conformance to Media Storage Service Class (Interchange Option). In addition Augmented conformance is provided to store extra data attributes important for the full feature support of the LEONARDO product SW. Details are listed in following Table:

Application Profiles Supported	Real-World Activity	Role	SC Option
PRI-XAMAS-CD PRI-XAMAS-MOD23 (option) PRI-XAMAS-MOD41 (option) AUG-XA1K-CD *1	Browse Directory Information	FSR	Interchange
	Import into local Storage	FSR	Interchange
	Export to local Archive Media	FSC, FSU	Interchange
STD-GEN-CD STD-XABC-CD STD-XA1K-CD	Browse Directory Information	FSR	Interchange
	Import into local Storage	FSR	Interchange

*1 – With no Private SOP Class used, the PRI-XAMAS-CD profile definitions are appropriate to describe the augmentation of the STD-XA1K-CD Profile.

On LEONARDO based Workstation Products the Private Extended MAS Profile (PRI-XAMAS-CD or optional the PRI-XAMAS-MOD23 or PRI-XAMAS-MOD41) will be preferably used by the system. The General Purpose Interchange Profile (STD-GEN-CD), Basic Cardiac Profile (STD-XABC-CD) and 1024 X-Ray Angiographic Profile (STD-XA1K-CD) will be supported with read capability of the related media.

3.1.1 File Meta Information for the Application Entity

The Source Application Entity Title is set by configuration. See Chapter "Configuration" for details.

3.1.2 Real-World Activities for this Application Entity

3.1.2.1 Real-World Activity: Browse Directory Information

The DICOM Archive application acts as FSR using the interchange option when requested to read the media directory.

The DICOM archive application will read the DICOMDIR and insert those directory entries, that are valid for the application profiles supported, into a local database. The database can the then be used for browsing media contents.

Note

IconImageSQ is also supported in DICOMDIR. But only those Icon Images with BitsAllocated (0028,0100) equal to 8 and size of 64x64 or 128x128 pixels are imported into database and are visible in the Browser.

3.1.2.1.1 Application Profiles for the RWA: Browse Directory Information

See Table in section 3.1 for the Application Profiles listed that invoke this Application Entity for the Browse Directory Information RWA.

3.1.2.2 Real-World Activity: Import into local Storage

The DICOM Archive application acts as FSR using the interchange option when requested to read SOP Instances from the medium into the local storage.

The SOP Instance selected from the media directory will be copied into the local storage. Only SOP Instances, that are valid for the application profile supported and are listed as supported by the Storage SCP Conformance section (Network DCS, 5.1.3), can be retrieved from media storage. This is due to the fact that the Browse Directory Information will filter all SOP Instances not matching the Application profiles supported.

During operation no "Attribute Value Precedence" is applied to the SOP Instances. Detached Patient Management is not supported.

For media conforming to the STD-GEN-CD Profile the following SOP classes will be supported as an FSR:

Information Object Definition	SOP Class UID	Transfer Syntax UID
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
CR Image	1.2.840.10008.5.1.4.1.1.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
CT image	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
MR Image	1.2.840.10008.5.1.4.1.1.4	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
NM Image	1.2.840.10008.5.1.4.1.1.20	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
CSA Non-Image	1.3.12.2.1107.5.9.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1

3.1.2.2.1 Application Profiles for the RWA: Import into local Storage

See Table in section 3.1 for the Application Profiles listed that invoke this Application Entity for the Import into Local Storage RWA.

3.1.2.3 Real-World Activity: Export to local Archive Media

The DICOM Archive application acts as FSU (for media with existing DICOM file-set) or FSC (media not initialized) using the interchange option when requested to copy SOP Instances from the local storage to local Archive Medium.

The DICOM Archive application will receive a list of SOP Instances to be copied to the local archive medium. According to the state of the medium inserted (new medium, Medium with DICOM file-set) the validity of the SOP Instances according to the applicable profile is checked. Only valid SOP Instances are accepted.

When the DICOM archive application is requested to copy SOP Instances the preferred application profile according configuration (AUG-XA1K-CD or PRI-XAMAS-xxx) will be used to validate and copy the referred SOP Instances. When creating a new file-set no Descriptor File will be allocated and the related ID is not used.

The DICOM archive application will not close the medium.

With the "Export 512 to ..." function of the Viewer or if configured as default transfer mode for the viewer, a copy of images in Cardiac Format (512x512, 8Bit) can be written onto medium. Please refer to the Storage section "Send 512 to ..." RWA description to learn more about the type of conversion that is performed on the Instances.

3.1.2.3.1 Application Profiles for the RWA: Export to local Archive Media

See Table in section 3.1 for the Application Profiles listed that invoke this Application Entity for the Export to local Archive Media RWA.

4 Augmented and Private Profiles

4.1 Augmented Application Profiles

4.1.1 AUG-XA1K-CD

With no private Siemens Non-Images stored onto Medium, the definitions of the PRI-XAMAS-CD Profile are applicable to denote the augmentations for the STD-XA1K-CD Standard Profile.

Storage of Private Information Objects will only be supported with reference to a Private Application Profile (see next section).

4.2 Private Application Profiles

4.2.1 PRI-XAMAS-CD, -MOD23, -MOD41

The DICOM Archive application is conforming to the PRI-XAMAS application profile class provided in a separate document. Please refer to next section for more information on specializations and extentions in accordance to this Application Profile.

5 Extensions, Specializations and Privatizations of SOP Classes and Transfer Syntaxes

The SOP Classes listed refer in majority to those created by the equipment to which this conformance Statement is related to. For SOP classes not listed in this section, please refer to the Storage section of the DICOM Conformance Statement of the product. This will include all SOP Instances that can be received and displayed and therefor will be included into offline media storage even though these SOP Instances are not created by the equipment serving the Media Storage Service.

5.1 SOP Specific Conformance Statement for Basic Directory

5.1.1 Extension, Specialization for SIEMENS Non-Image Objects

According to the PRI-XAMAS Application Profile Class the usage of the Private Creator UIDs and further optional keys for the Directory Records referring to SIEMENS Non-Image Objects are listed in the following tables.

Attribute	Tag	Value used
Private Record UID	(0004,1432)	1.3.12.2.1107.5.9.1
SOP Class UID	(0008,0016)	1.3.12.2.1107.5.9.1

For those "Non-Images" no Icon Image Sequence will be generated.

6 Configuration

6.1 AE Title Mapping

6.1.1 DICOM Media Storage AE Title

The DICOM Storage application provides the application entity title:

CsaImageManager

7 Support of Extended Character Sets

The Siemens LEONARDO DICOM archive application supports the ISO 8859 Latin 1 (ISO-IR 100) character set.

Also the Japanese language character sets JIS X 0201 (ISO-IR 13 Japanese katakana and ISO-IR 14 Japanese romaji), JIS X 0208 (ISO-IR 87 Japanese kanji) and JIS X 0212 (IOS-IR 159 Supplementary Japanese kanji) are supported.

A APPENDIX

A.1 Siemens Standard Extended Modules

A.1.1 CSA Image Header Module

The table in this section contains private IOD Attributes that describe the CSA Image Header:

Attribute Name	Tag	Owner	Type	Notes
CSA Image Header Type	(0029,xx08)	SIEMENS CSA HEADER	1	CSA Image Header identification characteristics. Defined Terms: NUM 4 = NUMARIS/4 SOM 5 = SOMARIS/5
CSA Image Header Version	(0029,xx09)	SIEMENS CSA HEADER	3	Version of CSA Image Header Info (0029,xx10) format.
CSA Image Header Info	(0029,xx10)	SIEMENS CSA HEADER	3	Manufacturer model dependent information.

A.1.2 CSA Series Header Module

The table in this section contains private IOD Attributes that describe the CSA Series Header:

Attribute Name	Tag	Owner	Type	Notes
CSA Series Header Type	(0029,xx28)	SIEMENS CSA HEADER	1	CSA Series Header identification characteristics. Defined Terms: NUM 4 = NUMARIS/4
CSA Series Header Version	(0029,xx29)	SIEMENS CSA HEADER	3	Version of CSA Series Header Info (0029,xx10) format.
CSA Series Header Info	(0029,xx20)	SIEMENS CSA HEADER	3	Manufacturer model dependent information.

A.1.3 MEDCOM Header Module

The table in this section contains private IOD Attributes that describe MEDCOM Header:

Attribute Name	Tag	Owner	Type	Notes
MedCom Header Type	(0029,xx08)	SIEMENS MEDCOM HEADER	1C	MedCom Header identification characteristics. Defined Terms: MEDCOM 1 (Required if MedCom Header Info (0029,xx10) present.)
MedCom Header Version	(0029,xx09)	SIEMENS MEDCOM HEADER	2C	Version of MedCom Header Info (0029,xx10) format. (Required if MEDCOM Header Info (0029,xx10) present.)
MedCom Header Info	(0029,xx10)	SIEMENS MEDCOM HEADER	3	Manufacturer model dependent information. The value of the attribute MedCom Header Info (0029,xx10) can be build up in each user defined format.
MedCom History Information	(0029,xx20)	SIEMENS MEDCOM HEADER	3	MedCom defined Patient Registration history information. See A.1.3.1.
PMTF Information 1	(0029,xx31)	SIEMENS MEDCOM HEADER	3	Transformation Information
PMTF Information 2	(0029,xx32)	SIEMENS MEDCOM HEADER	3	Transformation Information
PMTF Information 3	(0029,xx33)	SIEMENS MEDCOM HEADER	3	Transformation Information
PMTF Information 4	(0029,xx34)	SIEMENS MEDCOM HEADER	3	Transformation Information

A.1.3.1 MEDCOM History Information

The value of the attribute MEDCOM History Information (0029,xx20) is defined in the following way:

Part	Name	Type	Bytes	Notes
header	Identifier	string	32	Always “CSA HISTORY”
	Version	string	32	e.g. “V1.10”
n Items	Class Name	string	64	
	Modification String	string	1024	

A.1.4 MEDCOM OOG Module

Attribute Name	Tag	Owner	Type	Notes
CSA Series Header Type	(0029,xx28)	SIEMENS MEDCOM OOG	1	MEDCOM Object Oriented Graphics (OOG) identification characteristics. Defined Terms: MEDCOM OOG 1
CSA Series Header Version	(0029,xx29)	SIEMENS MEDCOM OOG	3	Version of MEDCOM OOG Info (0029,xx10) format.
CSA Series Header Info	(0029,xx20)	SIEMENS MEDCOM OOG	3	MEDCOM Object Oriented Graphics (OOG) data.

A.1.5 Angio Viewing Module

Attribute Name	Tag	Owner	Type	Notes
Review Mode	(0019,xx00)	SIEMENS SMS-AX VIEW 1.0	3	Special Modes for Angio Review. Defined Terms are 1 = REV_MAXFILL, 2 = REV_LOOP, 3 = REV_SCROLL, 4 = REV_STEREO_LOOP
Anatomical Background Percent	(0019,xx01)	SIEMENS SMS-AX VIEW 1.0	3	Percentage of Mix between Subtracted Image Result and Native Mask. Range is from 0 to 100.
Number of Phases	(0019,xx02)	SIEMENS SMS-AX VIEW 1.0	3	1-4 (1 or # of "Variable Frame Rate" acq phases)
Apply Anatomical Background	(0019,xx03)	SIEMENS SMS-AX VIEW 1.0	3	boolean
Pixel Shift Array	(0019,xx04)	SIEMENS SMS-AX VIEW 1.0	3	4 * Number of Frames (0028,0008)
Brightness	(0019,xx05)	SIEMENS SMS-AX VIEW 1.0	3	SUB windowing
Contrast	(0019,xx06)	SIEMENS SMS-AX VIEW 1.0	3	SUB windowing
Enabled Shutter	(0019,xx07)	SIEMENS SMS-AX VIEW 1.0	3	Visualize shutter
Native Edge Enhancement Percent Gain	(0019,xx08)	SIEMENS SMS-AX VIEW 1.0	3	Percent gain for native display of images.
Native Edge Enhancement LUT Index	(0019,xx09)	SIEMENS SMS-AX VIEW 1.0	3	
Native Edge Enhancement Kernel Size	(0019,xx0A)	SIEMENS SMS-AX VIEW 1.0	3	
Subtracted Edge Enhancement Percent Gain	(0019,xx0B)	SIEMENS SMS-AX VIEW 1.0	3	Percent gain for subtracted display of images.
Subtracted Edge Enhancement LUT Index	(0019,xx0C)	SIEMENS SMS-AX VIEW 1.0	3	
Subtracted Edge Enhancement Kernel Size	(0019,xx0D)	SIEMENS SMS-AX VIEW 1.0	3	

Fade Percent	(0019,xx0E)	SIEMENS SMS-AX VIEW 1.0	3	
Flipped before Laterality Applied	(0019,xx0F)	SIEMENS SMS-AX VIEW 1.0	3	
Apply Fade	(0019,xx10)	SIEMENS SMS-AX VIEW 1.0	3	

A.2 Registry of DICOM Data Elements

Tag	Private Owner Code	Name	VR	VM
(0019,xx00)	SIEMENS SMS-AX VIEW 1.0	Review Mode	US	1
(0019,xx01)	SIEMENS SMS-AX VIEW 1.0	Anatomical Background Percent	US	1
(0019,xx02)	SIEMENS SMS-AX VIEW 1.0	Number of Phases	US	1
(0019,xx03)	SIEMENS SMS-AX VIEW 1.0	Apply Anatomical Background	US	1
(0019,xx04)	SIEMENS SMS-AX VIEW 1.0	Pixel Shift Array	SS	4-4n
(0019,xx05)	SIEMENS SMS-AX VIEW 1.0	Brightness	US	1
(0019,xx06)	SIEMENS SMS-AX VIEW 1.0	Contrast	US	1
(0019,xx07)	SIEMENS SMS-AX VIEW 1.0	Enabled Shutters	US	1
(0019,xx08)	SIEMENS SMS-AX VIEW 1.0	Native Edge Enh. Percent Gain	US	1
(0019,xx09)	SIEMENS SMS-AX VIEW 1.0	Native Edge Enh. LUT Index	SS	1
(0019,xx0A)	SIEMENS SMS-AX VIEW 1.0	Native Edge Enh. Kernel Size	SS	1
(0019,xx0B)	SIEMENS SMS-AX VIEW 1.0	Subtr. Edge Enh. Percent Gain	US	1
(0019,xx0C)	SIEMENS SMS-AX VIEW 1.0	Subtr. Edge Enh. LUT Index	SS	1
(0019,xx0D)	SIEMENS SMS-AX VIEW 1.0	Subtr. Edge Enh. Kernel Size	SS	1
(0019,xx0E)	SIEMENS SMS-AX VIEW 1.0	Fade Percent	US	1
(0019,xx0F)	SIEMENS SMS-AX VIEW 1.0	Flipped before Laterality Applied	US	1
(0019,xx10)	SIEMENS SMS-AX VIEW 1.0	Apply Fade	US	1
(0029,xx08)	SIEMENS CSA HEADER	CSA Image Header Type	CS	1
(0029,xx09)	SIEMENS CSA HEADER	CSA Image Header Version	LO	1
(0029,xx10)	SIEMENS CSA HEADER	CSA Image Header Info	OB	1
(0029,xx18)	SIEMENS CSA HEADER	CSA Series Header Type	CS	1
(0029,xx19)	SIEMENS CSA HEADER	CSA Series Header Version	LO	1
(0029,xx20)	SIEMENS CSA HEADER	CSA Series Header Info	OB	1
(0029,xx08)	SIEMENS MEDCOM HEADER	MedCom Header Type	CS	1
(0029,xx09)	SIEMENS MEDCOM HEADER	MedCom Header Version	LO	1
(0029,xx10)	SIEMENS MEDCOM HEADER	MedCom Header Info	OB	1
(0029,xx20)	SIEMENS MEDCOM HEADER	MedCom History Information	OB	1
(0029,xx31)	SIEMENS MEDCOM HEADER	PMTF Information 1	LO	1
(0029,xx32)	SIEMENS MEDCOM HEADER	PMTF Information 2	UL	1
(0029,xx33)	SIEMENS MEDCOM HEADER	PMTF Information 3	UL	1
(0029,xx34)	SIEMENS MEDCOM HEADER	PMTF Information 4	CS	1
(0029,xx08)	SIEMENS MEDCOM OOG	MedCom OOG Type	CS	1
(0029,xx09)	SIEMENS MEDCOM OOG	MedCom OOG Version	LO	1
(0029,xx10)	SIEMENS MEDCOM OOG	MedCom OOG Info	OB	1

A.3 SC Standard Extended SOP Class

The LEONARDO Workstation will create functional images from special applications. Those will be encoded as SC Standard extended SOP Class. Please see the following table for complete overview of supplied Type 1/2/3 Standard and Private attributes:

"*overview of supplied attributes – SC derived image (Monochrome)"*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	(conf. Character Set is added, if needed)
Image Type	(0008,0008)	DERIVED\SECONDARY\\<algorithm>\<SW version> algorithm = SPINE or COLON or LLEG_ORTHO or LLEG_ANGIO or SPINE DLR or COLON DLR or LLEG_ORTHO DLR or LLEG_ANGIO DLR
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	(0008,0018)	
Study Date	(0008,0020)	from Original
Series Date	(0008,0021)	<yyyymmdd>
Acquisition Date	(0008,0022)	Derived from original Acquisition/Image Date or zero length
Image Date	(0008,0023)	<yyyymmdd>
Study Time	(0008,0030)	from Original
Series Time	(0008,0031)	<hhmmss>
Acquisition Time	(0008,0032)	Derived from original Acquisition/Image Time or zero length
Image Time	(0008,0033)	<hhmmss>
Accession Number	(0008,0050)	from Original
Modality	(0008,0060)	OT
Conversion Type	(0008,0064)	WSD
Manufacturer	(0008,0070)	Siemens
Institution Name	(0008,0080)	from WS Configuration
Institution Address	(0008,0081)	from WS Configuration
Referring Physician´s Name	(0008,0090)	from Original
Station Name	(0008,1010)	from WS Configuration
Study Description	(0008,1030)	from Original
Series Description	(0008,103E)	(see [0008,0008] 3rd value <algorithm>)
Institutional Department Name	(0008,1040)	from WS configuration
Performing Physician´s Name	(0008,1050)	input via "Correct" user interface possible
Admitting Diagnosis Description	(0008,1080)	from Original
Manufacturer´s Model Name	(0008,1090)	LEONARDO
Derivation Description	(0008,2111)	<algorithm> (see [0008,0008])
Patient´s Name	(0010,0010)	from Original
Patient ID	(0010,0020)	from Original
Patient´s Birth Date	(0010,0030)	from Original
Patient´s Sex	(0010,0040)	from Original
Device Serial Number	(0018,1000)	from WS Configuration
Secondary Capture Device ID	(0018,1010)	from WS Configuration
Date of Secondary Capture	(0018,1012)	<yyyymmdd>
Time of Secondary Capture	(0018,1014)	<hhmmss>
Secondary Capture Device Manufacturer	(0018,1016)	Siemens
Secondary Capture Device Manufacturer´s Model Name	(0018,1018)	LEONARDO
Secondary Capture Device Software Version	(0018,1019)	from WS Configuration
Software Version	(0018,1020)	from WS Configuration
Protocol Name	(0018,1030)	same as Series Description
Study Instance UID	(0020,000D)	from Original
Series Instance UID	(0020,000E)	
Study ID	(0020,0010)	from Original

Attribute Name	Tag	Value
Series Number	(0020,0011)	
Image Number	(0020,0013)	
Patient Orientation	(0020,0020)	zero length
Laterality	(0020,0060)	removed
Image Comments	(0020,4000)	
Samples per Pixel	(0028,0002)	1
Photometric Interpretation	(0028,0004)	MONOCHROME1 or MONOCHROME2
Rows	(0028,0010)	(defined by the number of original images used and the overlap by reconstruction algorithm)
Columns	(0028,0011)	from Original
Bits Allocated	(0028,0100)	from Original
Bits Stored	(0028,0101)	from Original
High Bit	(0028,0102)	from Original
Pixel Representation	(0028,0103)	0
Window Center	(0028,1050)	
Window Width	(0028,1051)	
Window Center & Width Explanation	(0028,1055)	
Study Comments	(0032,4000)	from Original
Overlay Rows	(60xx,0010)	
Overlay Columns	(60xx,0011)	
Overlay Description	(60xx,0022)	
Overlay Type	(60xx,0040)	G
Overlay Origin	(60xx,0050)	1\1
Overlay Bits Allocated	(60xx,0100)	same as (0028,0100) or 1 (if Overlay encoded in [60xx,3000])
Overlay Bit Position	(60xx,0102)	12 or 0 (if Overlay encoded in [60xx,3000])
Overlay Data	[60xx,3000]	(with Offline Media Instances) Graphics Overlay
Pixel Data	(7FE0,0010)	

"*overview of supplied attributes – SC derived image (RGB)"*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	from Original
Image Type	(0008,0008)	DERIVED\SECONDARY\\DRAWING\<SW version>
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	(0008,0018)	1.3.12.2.1107.5.4.10.serialnumber.<individual_uid>
Study Date	(0008,0020)	from Original
Series Date	(0008,0021)	<yyyymmdd>
Acquisition Date	(0008,0022)	from Original
Image Date	(0008,0023)	<yyyymmdd>
Study Time	(0008,0030)	from Original
Series Time	(0008,0031)	<hhmmss>
Acquisition Time	(0008,0032)	from Original
Image Time	(0008,0033)	<hhmmss>
Accession Number	(0008,0050)	from Original
Modality	(0008,0060)	OT
Conversion Type	(0008,0064)	WSD
Manufacturer	(0008,0070)	"Hectec GmbH"
Institution Name	(0008,0080)	from WS Configuration
Institution Address	(0008,0081)	from WS Configuration
Referring Physician´s Name	(0008,0090)	from Original
Station Name	(0008,1010)	from WS Configuration
Study Description	(0008,1030)	from Original
Series Description	(0008,103E)	"EndoMap Drawing"
Performing Physician´s Name	(0008,1050)	input via "Correct" or "EndoMap" user interface

Attribute Name	Tag	Value
		possible
Manufacturer´s Model Name	(0008,1090)	LEONARDO
Patient´s Name	(0010,0010)	from Original
Patient ID	(0010,0020)	from Original
Patient´s Birth Date	(0010,0030)	from Original
Patient´s Sex	(0010,0040)	from Original
Device Serial Number	(0018,1000)	from WS Configuration
Secondary Capture Device ID	(0018,1010)	from WS Configuration
Date of Secondary Capture	(0018,1012)	<yyyymmdd>
Time of Secondary Capture	(0018,1014)	<hhmmss>
Secondary Capture Device Manufacturer	(0018,1016)	“Hectec GmbH”
Secondary Capture Device Manufacturer´s Model Name	(0018,1018)	LEONARDO
Secondary Capture Device Software Version	(0018,1019)	EndoMap <SW-Version>
Software Version	(0018,1020)	from WS Configuration
Protocol Name	(0018,1030)	same as Series Description
Study Instance UID	(0020,000D)	from Original
Series Instance UID	(0020,000E)	1.3.12.2.1107.5.4.10.serialnumber.<individual_uid>
Study ID	(0020,0010)	from Original
Series Number	(0020,0011)	from Original
Image Number	(0020,0013)	from Original
Patient Orientation	(0020,0020)	zero length
Laterality	(0020,0060)	removed (zero length)
Image Comments	(0020,4000)	"EndoMap Drawing"
Samples per Pixel	(0028,0002)	3
Photometric Interpretation	(0028,0004)	RGB
Planar Configuration	(0028,0006)	0
Rows	(0028,0010)	Number of pixel rows based on calculated resolution
Columns	(0028,0011)	Number of pixel columns based on calculated resolution
Bits Allocated	(0028,0100)	8
Bits Stored	(0028,0101)	8
High Bit	(0028,0102)	7
Pixel Representation	(0028,0103)	0
Pixel Data	(7FE0,0010)	

A.4 XA Standard Extended SOP Class

The LEONARDO Workstation will create “screen-shots” (Store Monitor images) from the Angio Viewer application. Those will be encoded as XA Standard extended SOP Class. Please see the following table for complete overview of supplied Type 1/2/3 Standard and Private attributes:

“*overview of supplied attributes – XA derived image (Monochrome)”*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	(conf. Character Set is added, if needed)
Image Type	(0008,0008)	DERIVED\SECONDARY\SINGLE PLANE\SINGLE A(B)\STORE MONITOR
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.12.1
SOP Instance UID	(0008,0018)	
Study Date	(0008,0020)	from Original
Series Date	(0008,0021)	from Original
Acquisition Date	(0008,0022)	Derived from original Acquisition/Image Date or zero length
Image Date	(0008,0023)	<yyyymmdd>
Study Time	(0008,0030)	from Original
Series Time	(0008,0031)	from Original
Acquisition Time	(0008,0032)	Derived from original Acquisition/Image Time or zero length
Image Time	(0008,0033)	<hhmmss>
Accession Number	(0008,0050)	from Original
Modality	(0008,0060)	XA
Manufacturer	(0008,0070)	Siemens
Institution Name	(0008,0080)	from Original
Institution Address	(0008,0081)	from Original
Referring Physician´s Name	(0008,0090)	from Original
Station Name	(0008,1010)	from Original
Study Description	(0008,1030)	from Original
Series Description	(0008,103E)	from Original
Institutional Department Name	(0008,1040)	from Original
Performing Physician´s Name	(0008,1050)	input via "Correct" user interface possible
Admitting Diagnosis Description	(0008,1080)	from Original
Manufacturer´s Model Name	(0008,1090)	from Original
Patient´s Name	(0010,0010)	from Original
Patient ID	(0010,0020)	from Original
Patient´s Birth Date	(0010,0030)	from Original
Patient´s Sex	(0010,0040)	from Original
Patient’s Age	(0010,1010)	from Original
Patient’s Size	(0010,1020)	from Original
Patient’s Weight	(0010,1030)	from Original
Patient’s Address	(0010,1040)	from Original
Patient Comments	(0010,4000)	from Original
Contrast Bolus Agent	(0018,0010)	from Original
KVP	(0018,0060)	from Original
Device Serial Number	(0018,1000)	from Original
Software Version	(0018,1020)	from Original
Protocol Name	(0018,1030)	from Original
Contrast Bolus Ingredient	(0018,1048)	from Original
Distance Source to Detector	(0018,1110)	from Original
Distance Source to Patient	(0018,1111)	from Original
Estimated Radiographic Magnification Factor	(0018,1114)	from Original
Exposure Time	(0018,1150)	from Original
X-Ray Tube Current	(0018,1151)	from Original

Attribute Name	Tag	Value
Average Pulse Width	(0018,1154)	from Original
Radiation Setting	(0018,1155)	from Original
Radiation Mode	(0018,115A)	from Original
Image Area Dose Product	(0018,115E)	from Original
Intensifier Size	(0018,1162)	from Original
Imager Pixel Spacing	(0018,1164)	from Original
Positioner Motion	(0018,1500)	from Original
Positioner Primary Angle	(0018,1510)	from Original
Positioner Secondary Angle	(0018,1511)	from Original
Detector Primary Angle	(0018,1530)	from Original
Detector Secondary Angle	(0018,1531)	from Original
Shutter Shape	(0018,1600)	
Shutter Left Vertical Edge	(0018,1602)	as set
Shutter Right Vertical Edge	(0018,1604)	as set
Shutter Upper Horizontal Edge	(0018,1606)	as set
Shutter Lower Horizontal Edge	(0018,1608)	as set
Center of Circular Shutter	(0018,1610)	from Original
Radius of Circular Shutter	(0018,1612)	from Original
Collimator Shape	(0018,1700)	from Original
Collimator Left Vertical Edge	(0018,1702)	from Original
Collimator Right Vertical Edge	(0018,1704)	from Original
Collimator Upper Horizontal Edge	(0018,1706)	from Original
Collimator Lower Horizontal Edge	(0018,1708)	from Original
Center of Circular Collimator	(0018,1710)	from Original
Radius of Circular Collimator	(0018,1712)	from Original
Vertices of the Polygonal Collimator	(0018,1720)	from Original
Private Creator	(0019,00xx)	SIEMENS SMS-AX VIEW 1.0
Review Mode	(0019,xx00)	if existent in Original (Siemens AXIOM system)
Anatomical Background Percent	(0019,xx01)	as set
Number of Phases	(0019,xx02)	if existent in Original (Siemens AXIOM system)
Apply Anatomical Background	(0019,xx03)	as set
Pixel Shift Array	(0019,xx04)	as set
Brightness	(0019,xx05)	as set
Contrast	(0019,xx06)	as set
Enabled Shutters	(0019,xx07)	as set
Native Edge Enhancement Percent Gain	(0019,xx08)	as set
Native Edge Enhancement LUT Index	(0019,xx09)	as set
Native Edge Enhancement Kernel Size	(0019,xx0A)	as set
Subtracted Edge Enhancement Percent Gain	(0019,xx0B)	as set
Subtracted Edge Enhancement LUT Index	(0019,xx0C)	as set
Subtracted Edge Enhancement Kernel Size	(0019,xx0D)	as set
Fade Percent	(0019,xx0E)	as set
Flipped before Laterality applied	(0019,xx0F)	
Apply Fade	(0019,xx10)	as set
Study Instance UID	(0020,000D)	from Original
Series Instance UID	(0020,000E)	from Original
Study ID	(0020,0010)	from Original
Series Number	(0020,0011)	from Original
Image Number	(0020,0013)	
Patient Orientation	(0020,0020)	From Original or zero length
Image Comments	(0020,4000)	SM
Samples per Pixel	(0028,0002)	1
Photometric Interpretation	(0028,0004)	MONOCHROME2

Attribute Name	Tag	Value
Rows	(0028,0010)	from Original
Columns	(0028,0011)	from Original
Bits Allocated	(0028,0100)	from Original
Bits Stored	(0028,0101)	from Original
High Bit	(0028,0102)	from Original
Pixel Representation	(0028,0103)	0
Pixel Intensity Relationship	(0028,1040)	DISP
Window Center	(0028,1050)	
Window Width	(0028,1051)	
Representative Frame Number	(0028,6010)	1
Study Comments	(0032,4000)	from Original
Performed Procedure Step Start Date	(0040,0244)	from Original
Performed Procedure Step Start Time	(0040,0245)	from Original
Performed Procedure Step ID	(0040,0235)	from Original
Request Attributes Sequence	(0040,0275)	from Original
> *item contents as provided*		
Overlay Rows	(60xx,0010)	
Overlay Columns	(60xx,0011)	
Overlay Description	(60xx,0022)	
Overlay Type	(60xx,0040)	G
Overlay Origin	(60xx,0050)	1\1
Overlay Bits Allocated	(60xx,0100)	same as (0028,0100) or 1 (if Overlay encoded in [60xx,3000])
Overlay Bit Position	(60xx,0102)	12 or 0 (if Overlay encoded in [60xx,3000])
Overlay Data	[60xx,3000]	(with Offline Media Instances) Graphics Overlay
Pixel Data	(7FE0,0010)	